Avian and Exotic Pets

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Speaker Profile

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Michael is a well-known Australian avian veterinarian who has tremendous experience over the past 32 years working with pet birds in private practice and in aviculture as well as wildlife parks and zoos. His practice covers a wide variety of animals, including dogs, cats, reptiles, rodents, rabbits, ferrets, guinea pigs, fish and invertebrates. Michael is a fine educator, having delivered lectures and seminars on avian and exotic pet topics to veterinarians nationally and internationally.

Michael graduated BVSc from the University of Sydney in 1976. He was awarded Member of the Australian College of Veterinary Scientists in the Chapter of Avian Health in 1984. He received his Graduate Diploma in Education from University of Technology Sydney in 1991.

Program

9.00 - 10.30	**Clinical Examination: The patient has arrived, what do I do now?** This presentation will cover what you and your staff can do to begin the process of arriving at a diagnosis when an avian or exotic patient presents for a diagnosis.
10.30 -11.00	**Morning Tea**
11.00 - 12.30	**Diagnostics: Clinical Pathology and Imaging** This presentation will contain case reports and discussion to demonstrate how to use these diagnostic modalities effectively in your practice.
12.30 - 1.30	**Lunch**
1.30 - 3.00	**Common problems in avian, reptilian and small mammalian patients** This presentation will contain case reports and discussion of common presentations in birds, reptiles, rabbits, ferrets, guinea pigs, rats & mice.
3.00 - 3.30	**Afternoon Tea**
3.30 - 5.00	**Common Problems in avian, reptillian and small mammalian patients continued...**

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Chapter 1

Avian Clinical Examination

Dr Michael Cannon

A clinical examination consists of the following components:

1. History

2. Examination of Environment

3. Distant Examination

4. Physical Examination

5. Body Weight

6. Basic Laboratory Tests

I find it is useful to adopt a consistent approach to examining all cases. As with all animals, a diagnosis must be based upon more than the clinical pathology tests that are available. Collect a full history, perform an examination of the environment and decide which tests you are most likely to choose. Collect all the equipment you will require before moving onto the physical examination. This allows you to be as efficient as possible with your examination and causes less stress for the bird.

The clinical examination procedure should not begin as the client walks into the consulting room, but with the client's first contact with the Veterinary Hospital - in most cases this will be with a telephone call. A well-trained Veterinary Nurse can give this procedure a good foundation by giving clear instructions to the client before they come. This will help make your examination more fruitful.

CLIENT INSTRUCTIONS PRIOR TO ATTENDING

- Remove any swings, toys etc. that may move around and injure the bird during transport.
- If it is cold or windy, cover the cage to protect the bird.
- Bring the bird in the cage it normally lives in or in the cage it is presently living in if that is different
- Do not clean the cage prior to coming in. Leave all food and water dishes as they are. Leave any vomitus, diarrhoea etc.
- Remove the water dish and empty it before coming so that it does not spill and change the character of any droppings.
- Bring any medications etc. that have been used.
- Make sure that the bird is accompanied by someone who knows the current history. If they are unable to attend have a telephone contact available, or provide a detailed written history.

As a general rule of thumb, any caged bird that appears ill to its owner is seriously ill. To emphasise the problems associated with ill birds I usually mention to a client that one day of illness in a small, pet bird is roughly equivalent to one week of illness for a human.

You may find it useful to place the following list near the telephone for you or your nurse to discuss with a client seeking advice about an ill bird. The list includes clinical signs, easily recognisable by the concerned bird owner, which may suggest significant problems for the bird

General Signs

- Weight loss
- Reduction in appetite or complete cessation of eating
- Inability to adequately swallow or manipulate food within the mouth
- Vomiting
- Fluffed feathers - huddled appearance
- Inactivity
- Droopy wings

- Decrease in preening activity and maintenance of feathers
- A break in bird's routine - abnormal behaviour
- Cessation of vocalisation
- Change of voice
- Visible lumps or masses - anywhere on the body
- Bleeding - always should be treated as an emergency situation

Eyes

- Unilateral or bilateral discharges
- Changes in clarity or colour
- Closing of one or both eyes - partial (squinting) or complete
- Swelling around one or both eyes

Nostrils/Nares

- Soiling of feathers around nostrils or of the head feathers
- Unilateral or bilateral discharges
- Plugged - one or both nostrils

Respiratory

- Open-mouthed breathing when at rest (very serious)
- Tail bobbing (rhythmic back and forth motion of the tail when at rest)
- Sneezing, wheezing, gasping etc.

Musculoskeletal/Neurological

- Balance problems
- Inability to perch (bird on cage bottom)
- Limping or lack of full weight-bearing on one limb
- Swollen foot/feet and or joint/joints

Droppings

- Change in quality and/or quantity of components of droppings

PRESERVATION REFLEX

One of the most frustrating problems in avian medicine is the fact that birds do not display illness in the same manner as dogs, cats or the other mammals we are accustomed to treating. Birds possess the ability to mask most of the symptoms (lethargy, depression, anorexia etc) that we would normally associate with the early stages of a disease process. Many serious illnesses are kept at a sub-clinical state until the process is quite advanced. This is often referred to as the Preservation Reflex, as the current theory used to explain this phenomenon is that the bird does not show overt or clinical signs of illness in order to preserve itself from attack by predators or to preserve its position in the “Peck Order”.

The significance of this reflex is that simply performing a visual examination of an avian patient is insufficient to assess its health status. The approach to an avian patient is different, and more attention must be paid to small details and an effort made to detect the very subtle, early signs of disease. The clients must be educated to be more aware of any subtle changes in their bird and they must understand that if a bird displays signs of illness this must be acted upon much more quickly than with other pets such as cats and dogs.

By the time birds display clinical signs of illness it is usually a sign that they have reached a stage of decompensation and can no longer mask their illness. They are commonly in an advanced or serious stage of their disease process.

From a practitioner's point of view this helps to explain why a client will present with a bird in an advanced state, but believing that he has been ill for only a short period, and the commonly held opinion that birds are “soft” creatures and die very easily from apparently minor illnesses.

HISTORY

The time spent collecting the history should allow the bird to settle down from the excitement of transport. A bird that is masking symptoms of disease may look normal initially and then display subtle signs after a few minutes - if it has reached a stage of decompensation.

I use a few key questions at the top of my hospital examination sheet to remind me to ask the basic questions (see Fig 1.). This often is filled in at admission by my Veterinary Nurse and passed on to me so that I can consider it before I see the bird.

The basic questions that should be asked are:

1. Is the bird a pet or normally kept in an aviary?

If it is a pet bird, does it always stay in the cage or does it have periods of free flight?

If it is in an aviary ask for a description noting the size, floor type, design, aspect it faces and any preventative medicine program currently in use.

2. Any recent changes to the environment?

This may indicate sources of stress or toxins.

Which disinfectants are used? What is the substrate provided?

What is the normal photoperiod provided? Many birds are exposed to very long light intervals - much longer than the natural interval.

3. The age of the bird?

Determining the age of a fully-grown bird can be difficult.

Immature birds often seem to have large eyes. This is an illusion caused by large amounts of black pigment in the iris. The beak and exposed, featherless skin appear to be smoother in young birds. Young birds are more prone to infectious diseases, while older birds are more likely to have age related problems such as neoplasia.

4. How long have they had the bird?

This is an indirect estimate of the bird’s minimum age. It is also a lead in to the following question. A bird that has been established in a stable environment is more likely to have nutritional, psychological or neoplastic disease, while a newly acquired bird is more likely to have an infectious disease or stress.

5. If the bird was acquired recently, from what source?

Birds that have recently been through a bird dealer's premises will have been exposed to a host of infectious diseases.

6. History of recent illnesses?

Of this patient or of any other birds on the premises.

7. Any medications used? (Check dose, frequency etc.)

Always ask the client to describe how the drug was used to rule out any errors in administration.

8. Are any other birds or members of the family ill?

Consider zoonoses or common toxicities. Beware pet parrots, which may mimic a sneeze or cough.

9. Any other birds acquired recently?

Also question about quarantine procedure used.

10. Have there been any changes to the bird's behaviour?

Behavioural changes are often the first subtle signs that are available. These are often overlooked. Has the bird been less active or sitting in an uncommon position? Does the bird allow you to come closer before moving away? Are there periods of huddling, excessive sleeping or hiding?

11. Current diet and any recent changes to the diet?

Nutritional disease is extremely common. The majority of birds are suffering from malnutrition (especially overconsumption of fat). While a full range of food may be supplied, check that the bird is consuming a wide range. Many birds will eat sunflower seed to the exclusion of all other foods. Note any change in food or water consumption.

EXAMINATION OF ENVIRONMENT

While the history is being gathered you can also quickly visually assess the cage. Look for signs of vomitus. Note the type of seed in the feed container. Is the seed being eaten - assess the amount of husks present. Are any supplements offered other than seed? Is the water dish clean? Make an assessment of the level of hygiene and sanitation. Look at the droppings - is there an increased or decreased number? Assess the urinary and faecal components of several droppings present for colour, consistency and volume. Expect a temporary polyuria due to the stress and excitement of transport.

DISTANT EXAMINATION

Spend a little time assessing the bird’s demeanour (should be alert and responsive). Note the bird's posture (should have erect stance with weight evenly spread on both feet). Is it normally active? Are there any obvious physical abnormalities? Assess respiratory rate and depth. Make a subjective assessment of the bird's weight.

PHYSICAL EXAMINATION

The bird should be given a complete physical examination. I prefer to start at the head and move distally. You should develop this as a habit and carry out the examination the same way each time so that nothing is overlooked. Pay particular attention to any suggestive signs detected during the history and distant examination. Using an examination form similar to that presented at the end of this paper can assist with performing a thorough examination (Figure 1).

- Begin by examining the head, eyes, ears and nares/cere (pay particular attention to the feathers immediately adjacent to the nares as even a mild discharge will make dust adhere to them and give them a stained appearance - this is the equivalent of a “runny” nose). The head should be symmetrical. Examine the beak for erosions or malformation. Sublaminar bruising of the beak may be associated with liver disease or trauma.
- Open the mouth and examine the tongue, choana and pharynx - note any sour or abnormal odours. Is there excessive mucous or are cheesy plaques present? Examine the papillae lining the choana - in chronic respiratory disease the papillae will be reduced or absent.

- Carefully palpate the entire bird beginning at the crop and working down the keel to the abdomen. The crop may contain food but rarely fluid. In aviary birds the crop will be empty in the middle of the day as they eat early in the day and late in the evening, similar to birds in the wild. Pet birds will often eat all day. In a young bird delayed crop emptying is often the first sign of disease. The oesophagus passes down the right side of the neck and is usually thin unless the parents are feeding young. The pectoral muscle mass should be convex and the keel bone should not be prominent. The abdomen should be concave not convex. The lower abdominal contents are often easily palpable. The gizzard is found in the lower left quadrant. Usually if the liver edge (most easily found on the right) can be palpated it is enlarged. If the abdomen is enlarged palpation must be extremely gentle. The bird should not demonstrate pain with normal, gentle abdominal palpation. In finches and canaries, wetting the abdominal wall with alcohol can allow visualisation of the lower abdominal contents. A darkening of the intestinal area is usually indicative of inflammation.

- Examine the vent for swellings, encrustations or soiling (indicative of loose droppings). If the tail is flexed dorsally, the vent will open and allow inspection of the cloacal mucosa or insertion of a swab.

- Examine the feathers and skin. Look for any missing or chewed feathers. Are any feathers dystrophic - particularly the primary flight and tail feathers or the powder down feathers? Does the bird have a powder covering?

- Pull out each wing individually. Palpate the bones from shoulder to wing tip. Examine each joint for a full range of motion or any swelling. Extend each wing and hold up to a bright light source to transilluminate the feathers. Spray alcohol on the skin if closer inspection is required. This may reveal bruising of a swollen area.

- Examine each leg individually. Palpate from hip to distal end of each digit, paying particular attention to the joints. Assess the gripping ability of each toe. A weak grip may be indicative of abdominal tumours, fractures or neurological disease. Unilateral lameness is more common than bilateral. Assess the length of the claws. Overgrown claws may be associated with hepatopathy. Sublaminar haemorrhage in the claws (similar to the beak) may be a sign of hepatopathy or trauma. Inspect the plantar aspect of each foot space- the papillae should be visible. Lack of papillae may be the first sign of incorrect perching material, or the beginning of bumblefoot.

- Auscultate the chest (dorsal and ventral) and the abdomen. Heart rate is extremely variable and may be impossible to count. The sounds of inspiration are louder and shorter in duration than expiration. Abnormal respiratory wheezes or whistling are signs of severe pathology.

- This whole procedure should take less time to perform than it takes to read.

Once the examination is finished immediately place the bird back into its cage and assess its tolerance of the procedure. Most birds will look normal and many will preen themselves to reposition any feathers ruffled by your hand. If the bird looks obviously stressed or is breathing heavily, it is safe to assume it is ill.

BODY WEIGHT

This is an extremely useful tool in health assessment. The bird should be placed upon a set of scales (either triple beam balance or small electronic scales) and an accurate measurement taken. I find it useful to place them in a large paper bag during this procedure. This minimises struggling and panic. Objective weight measurement can be used as a regular monitor to assess the bird and should be recorded on the bird's card. As an in-hospital tool, objective measurement is an excellent prognostic indicator for a bird receiving treatment. Weight loss is always a sign of a poor prognosis.

As well it is useful to make a subjective assessment of the bird's general condition after palpating the pectoral muscles. The keel bone should not be prominent. With time and experience this can be used to determine the optimum weight for an individual bird. This is a useful skill for clients to develop as a general health assessment tool.

BASIC LABORATORY TESTS

If the bird is coping with the restraint, some samples for laboratory tests may be collected, depending upon the history and physical examination. Use the history as a guide to have any possible diagnostic equipment prepared before the bird is restrained so that the procedure is not prolonged and flows on from the physical examination. This will be discussed in more detail in Module 2.

The **common basic tests** that may be indicated are:

- **Cloacal and choanal swabs** for Gram stain and possibly Culture and Sensitivity
- **Faecal flotation and faecal saline smear** (both should be performed)
- **Blood collection/haematology**

  i. Haematocrit for

    PCV and TPP

  ii. Blood smear for

    WBC estimation

    Differential count

    RBC morphology

    Haemoparasite exam

  iii. Serum Biochemistry tests as indicated/available.

Cloacal/Choanal Swabs

Use standard microbiological swabs placed into the appropriate collection site. To reduce damage to tissues it is recommended that the swabs be first moistened with sterile saline. These are then placed into transport medium after a sample is rolled onto a sterile microscope slide that can be used for a Gram stain.

Blood Collection

(for a more complete discussion see Dein, 1984)

The commonly used sites for routine blood collection are:

1. **Toenail Clip.** This is a simple and effective method. If a sharp pair of nail clippers (the pair you normally use for dogs and cats is fine) is used the birds don't seem to experience much discomfort. Be sure to clean the nail with an alcohol swab, to remove any faecal or urate contamination, before collecting the sample - particularly if you wish to measure uric acid blood levels. Hold the leg extended and relax the toes or you will not be able to sustain a good blood flow. The blood can be collected directly into a microhaematocrit tube from the tip of the toenail. If applied incorrectly this can be a painful experience for the patient so it is no longer the favoured technique.

2. Use a needle to prick the skin directly over the **medial metatarsal vein**. A small drop of blood will form and this can be collected into a microhaematocrit tube.

3. Insert a needle (26-30 ga) into either one of the **jugular veins** or the **cutaneous ulnar veins**. In many birds the right jugular vein is larger and more accessible. Collect into a microhaematocrit tube directly from the hub of the needle, or into a tuberculin syringe. This is the most commonly used technique in Australia and overseas.

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Appendix 1

AVIAN CLINICAL EXAMINATION

Name: ___________________________ Street: ______________________________

Phone: ________________________ Suburb: _________________ Postcode: _______

Date: ___________ Species: __________________________ Age: ____ Sex: M F

Presenting Complaint: ____

Pet/Aviary*; New/Old*; Behaviour Changes: _________________________________

Medications used: ____

Diet: ____ Weight: ___________

History:____

	N	A	NE		N	A	NE
(1) Position in cage				(6) Legs			
(2) Respiration				(7) Keel			
(3) Head/Eyes				(8) Abdomen			
(4) Feathers/Beak				(9) Vent			
(5) Wings				(10) Auscultation			

Describe abnormal findings noted above:

		Fee	Credit	Balance
Faeces Gross:				
Faecal Float:				
Crop Wash:				
Other Tests:				
Diagnosis:	Definite Tentative *			

Treatment:

* = circle one N = Normal A = Abnormal NE = Not Examined

NOTES:

NOTES:

Chapter 2

Reptile Clinical Examination – What's Normal and What's Not

Dr Michael Cannon, Cannon & Ball Veterinary Clinic

Dr Robert Johnson, South Penrith Veterinary Clinic

A Clinical Examination of a reptile consists of the following components:

1. History

2. Examination of Environment

3. Distant Examination

4. Physical Examination

5. Body Weight

6. Snout: Cloaca Measurement (Body Length)

7. Determination of Gender

8. Basic Diagnostic Procedures

I find it is useful to adopt a consistent approach to examining all cases. As with all animals, a diagnosis must be based upon more than the clinical pathology tests that are available. Collect a full history, perform an examination of the environment and decide which tests you are most likely to choose. Collect all the equipment you will require before moving onto the physical examination. This allows you to be as efficient as possible with your examination and causes less stress for the reptile.

INTRODUCTION

The clinical examination procedure should not begin as the client walks into the consulting room, but with the client's first contact with the Veterinary Hospital – in most cases this will be with a telephone call. A well-trained Veterinary Nurse can give this procedure a good foundation by giving clear instructions to the client before they come. This will help make your examination more fruitful.

CLIENT INSTRUCTIONS PRIOR TO ATTENDING

- If it is cold or windy, take the necessary steps to protect the reptile.
- Closely examine the cage floor prior to coming in. Bring in the cage floor covering or a sample of any vomitus, diarrhoea etc.
- Bring any medications etc. that have been used.
- Make sure that the reptile is accompanied by someone who knows the current history. If they are unable to attend have a telephone contact available, or provide a detailed written history.

You may find it useful to place the following list near the telephone for you or your nurse to discuss with a client seeking advice about an ill reptile. The list includes clinical signs, easily recognisable by the concerned reptile owner, which may suggest significant problems for the reptile:

General Signs

- Weight loss
- Dehydration
- Abnormal odour
- Seeking areas of higher temperature (behavioural fever)
- Changes to skin or mucous membranes
- Reduction in appetite or complete cessation of eating
- Inability to adequately swallow or manipulate food within the mouth
- Swelling around head, mouth or neck
- Vomiting/regurgitation or rejection of food
- Inactivity
- A break in reptile's routine – abnormal behaviour
- Visible lumps or masses – anywhere on the body
- Bleeding – always should be treated as an emergency situation
- Abnormal skin shedding (dysecdysis)

Eyes

- Unilateral or bilateral discharges
- Changes in clarity or colour
- Closing of one or both eyes –partial (squinting) or complete
- Swelling around one or both eyes

Nostrils/Nares

- Unilateral or bilateral discharges
- Plugging of one or both nostrils
- Bubbles appearing at nares

Respiratory

- Open-mouthed breathing when at rest (very serious)
- Audible respiratory noises (Sneezing, wheezing, gasping etc.)
- Forks of tongue not separating (snakes & varanids)

Musculoskeletal/Neurological

- Balance problems
- Inability to coil on branches or logs
- Limping or lack of full weight-bearing on one limb
- Swollen foot/feet and or joint/joints

Scats

- Change in quality and/or quantity of components of scats

HANDLING & TRANSPORT

Many different containers are used to transport reptiles including bags, pillow slips, boxes and bins. It should be noted that any container used to transport a reptile should be leak proof, crush proof and secure. Special conditions apply for the transport of venomous species. Confidence, knowledge and assistance are required when handling reptiles. Depending on the order and species various precautions need to be taken.

Chelonia

- Glands either end of the bridge (between plastron and carapace) discharge a pungent fluid.
- Side-necked turtles – All except one Australian freshwater species are side-necked. The necks are usually difficult to straighten and examine.
- Restrain by holding the caudal or lateral edge of the carapace. Avoid the mouth in *Emydura spp* (short-necked).

Lizards

- Tails may drop off when handling some lizards (small skinks and geckoes).
- Some may bite, e.g. Blue-tongued lizards, bearded dragons and eastern water dragons.
- Some may bite, scratch and flick their tail, e.g. varanids (monitors).

Snakes

- Pythons of all sizes may bite and constrict
- Venomous snakes must be accurately identified before the physical examination and only handled if the handler is experienced and known by the veterinarian to be competent. There is no need for any veterinarian to "head" or catch a venomous snake. Never put your hand in a "snake bag" without knowing EXACTLY what is in it!

1. HISTORY

The time spent collecting the history should allow the reptile to settle down from the excitement of transport. Use this time to perform a distant examination of the patient to look for subtle signs of disease.

The basic questions that should be asked are:

- **If the reptile was acquired recently, from what source**? Wild caught or captive bred? Reptiles that have recently been through a transfer may have been stressed or exposed to a host of infectious agents and environmental conditions. Some sources are known by reputation to be either good or bad.

- **What is the animal's age?** Often this is unknown. If it was hatched recently has it undergone its first slough (ecdysis).
- **How long has the reptile been in its present environment?** Is the animal settling in to a new environment or is it well established. New arrivals are more likely to suffer from stress and acute problems such as infectious diseases. Established animals are more likely to suffer from husbandry problems, dietary problems or chronic diseases such as neoplasia or parasites.
- **Any recent changes to the environment**? This may indicate sources of stress or toxins.
- **The size and type of cage?** Pay particular attention to the nature of the floor surface or substrate. What are the climbing and hiding facilities provided? Is the reptile normally kept in an indoor enclosure or an outdoors aviary? If it is in an aviary ask for a description noting the size, floor type, design, aspect it faces and any preventative medicine program currently in use?
- **The frequency of cage cleaning and the cleaning methods used?** This is a means of determining the client's approach to hygiene and some potential sources of toxins.
- **The range of temperature and humidity in the cage?** Is there a temperature gradient in the cage? Is there a basking spot and what is the temperature where the reptile is able to bask?
- **Water supply?** Determine the source and quality of the water and the type of water container used. How often is the water changed? Are there bathing facilities? What is the size and how often it is used?
- **Light sources?** Type of light provided (incandescent, fluorescent). What is the availability of ultraviolet light or exposure to direct sunlight? What is the normal photoperiod provided? Many reptiles housed indoors are subject to internal lighting as people are in the room. This can result in them being exposed to very long light intervals – much longer than the natural interval.
- **Describe any cage mates?** Pay attention to size, gender, species and any interactions. What is their health status? Any new introductions to or departures from the enclosure – when was the most recent? Any other reptiles acquired recently in the collection? Also question about quarantine procedure used.

- **What are the characteristics of the diet?** Nutritional disease is extremely common. Many reptiles are suffering from malnutrition (especially obesity).
    - Type of food items provided
    - Quantity offered
    - Frequency of feeding
    - Method of presentation
    - Any supplements provided
    - When was the last meal
- **Describe the recent scats (faeces/urates/urine) passed?** What was its relation to feeding (normally should be passed within 4-5 days of a feed)?
- **Describe the most recent skin shedding (ecdysis)?** When did it occur? Was it normal?
- **Describe normal handling?** How often is it done? Describe the techniques used? Is the reptile a pet that is handled regularly?
- **Have there been any changes to the reptile's behaviour**? Behavioural changes are often the first subtle signs that are noticeable. These are often overlooked. Has the reptile been less active or sitting in an unexpected position? Does the reptile respond differently to the owner's presence or approach? Are there periods of excessive inactivity or hiding?
- **What are the current signs of disease that are causing concern & how long have they been evident?** Describe these signs of this patient or of any other reptiles on the premises.
- **What treatments or medications have been used?** What was the response to these? Check the dose, frequency etc. Always ask the client to describe how the drug was used to rule out any errors in administration.

2. EXAMINATION OF ENVIRONMENT

Often this is not available as the animals come in a cloth bag or small travel cage. Much of the information regarding the environment will be gathered during the history taking or a visit to their home.

While the history is being gathered you can also quickly visually assess the animal, its current environment or any scats that have been passed, to glean any further information that may be available. Take note of such details as cleanliness of the water dish or transport enclosure. Use this observation to make an assessment of the general level of hygiene and sanitation.

3. DISTANT EXAMINATION

Spend a little time assessing the reptile's demeanour (alert and responsive). Is it normally active? Are there any obvious physical abnormalities? Assess respiratory rate and depth. Make a subjective assessment of the reptile's weight by assessing the level of fat deposition at the base of the tail or at the latero-dorsal body wall.

Make an assessment of general appearance and behaviour[1].

- ***Chelonians***[1]***:*** Bright, alert and responsive. Swim evenly balanced in the water. When first caught, they pull their head and limbs beneath the carapace and strongly hold them in when you try to remove them. When walking, they support all the weight on their legs. The plastron bears no weight and does not touch the ground.
- ***Lizards***[1]***:*** They stand high and strongly on all four limbs. The body and limb muscles are well rounded and firm. There is no excessive folding or creasing of the skin. They run away quickly when you attempt to catch them.
- ***Snakes***[1]***:*** The body is flat on the substrate with the weight borne by the ventral scales. They respond to you approaching them by moving their head and flicking their tongue. If they feel threatened they will form a coil. If not they will begin to explore the surroundings.
- ***Crocodilians***[1]***:*** They have a very sedentary life, rarely moving unless threatened or at feeding time. Resent handling and restraint. Will thrash their head and neck, trying to bite, while lashing their tail in your direction.

4. PHYSICAL EXAMINATION

The reptile should be given a complete physical examination. I prefer to start at the head and move distally. You should develop your approach to the examination as a habit and carry out the examination the same way each time so that nothing is overlooked. Pay particular emphasis to any suggestive signs detected during the history and distant examination, so that they may be explored in more detail.

- Begin by examining the head, eyes, ears and nares (pay particular attention to the nares as dried discharge may occlude on or both- this is the equivalent of a "runny" nose). The head should be symmetrical.
- Examine the skin creases around the eyes ventral neck and labial pits as this is often a location to detect mites. Avoid handling snakes and lizards if the animal is in ecdysis.
- Assess the hydration status. Signs of dehydration are: decreased turgor – skin tents when pulled from the animal; skin is standing in multiple folds; abnormal ecdysis; in snakes and some lizards, spectacle is shrunken and opaque; sunken eyes in lizards, chelonians and crocodilians.
- Open the mouth and examine the tongue, teeth, gums, other oral structures and pharynx – note any sour or abnormal odours. Is there excessive mucous or are cheesy plaques or petechiae present? Examine the gum margins carefully for any sign of necrosis or ulceration.
- Carefully palpate the entire body, beginning at the neck and working down the body. Gently palpate the ventral coelomic cavity between the ribs. Feel for organs and any firm masses or fluid accumulation. Take care if the animal has been fed recently that you do not place pressure on the ingesta as it is passing through the intestine. An animal that has eaten recently may regurgitate if the stress of handling is too great.
- Locate the cardiac impulse and auscultate the heart and surrounding lungs. Auscultate the chest (dorsal and ventral) and the abdomen. Heart rate is extremely variable and may be difficult to count. The sounds of inspiration are louder and shorter in duration than expiration. Abnormal respiratory wheezes or whistling are signs of severe pathology. Most unrestrained reptile s will have 1-2 respirations per minute. Healthy animals breathe with the mouth closed. Rate and depth of respiration will vary with the ambient temperature.
- The body wall muscle mass should have firm muscle tone. The lower coelomic cavity contents are often easily palpable. If the abdomen is enlarged palpation must be extremely gentle. The reptile should not demonstrate pain with normal, gentle abdominal palpation.
- Examine the cloaca and vent for swellings, encrustations or soiling (indicative of loose droppings). If the tail is gently flexed dorsally, the vent will open slightly and allow inspection of the cloacal mucosa or insertion of a swab or sexing probe.

- Most reptiles will pass faeces that is formed. Urates are often passed at the same time. Normally they precede the stool. Urates are normally chalky paste that is pure white to yellow in colour. Terrestrial reptiles will also pass a small amount of clear liquid urine.
- Biliverdinuria (green discoloration of the urates) is abnormal and is usually associated with liver disease, anorexia or haemolytic anaemia. The reptiles have biliverdin rather than bilirubin.
- Any abnormal faeces should be examined, by performing a faecal flotation and fresh warm, saline smear.
- Examine the skin. Look for any missing scales or scars. Assess any lumps or swellings present.
- Pull out each limb individually. Palpate the bones from shoulder or hip to distal end of each digit, paying particular attention to the joints. Examine each joint for full range of motion or any swelling. A weak limb may be indicative of abdominal tumours, fractures or neurological disease. Unilateral lameness is more common than bilateral. Assess the length of the claws. Overgrown claws may be associated with poor substrate. Inspect the plantar aspect of each foot.
- This whole procedure should take less time to perform than it takes to read.

Once the examination is finished immediately place the reptile back into its cage and assess its tolerance of the procedure. Most reptiles will return to normal behaviour. If the reptile looks obviously stressed or is breathing heavily, it is safe to assume it is ill.

Hints for Specific Reptile Groups

The technique for physical examination of reptiles is similar in principle to that used for most other pets. Animals must be adequately restrained but not distressed. Like most other animals, reptiles resent oral examination.

Chelonia

- Chelonia are generally easy to handle. A healthy turtle can be surprisingly mobile. Demeanour varies from species to species. Of the commonly occurring species the common eastern longnecked turtle is quite docile. Short-necked turtles (*Emydura spp*) are usually more mobile and liable to bite.

- Turtles should be weighed and measured (straight carapace length [SCL]). A data base can be developed and used to gauge body condition[4].
- Carapace and plastron injuries and lesions are common. A central groove in the carapace deepens with age.
- Skin lesions may be an indication of more serious disease.
- Oral examination may be revealing in an otherwise healthy animal. Look for crusts, ulceration and rostral abrasion. Abscesses occur frequently, especially around the eyes and ears.
- Oedema of the neck and limbs with accompanying petechial haemorrhages may indicate septicaemia.

Squamata

i. Lizards

- The attitude of lizards varies greatly with species, age and state of health. The larger skinks such as blue-tongued lizards (*Tiliqua chelonian*) and shingle backs (*Tiliqua rugosa rugosa*) are usually placid and used to handling. Bearded dragons, except for the eastern species (*Pogona barbata*) are also quite docile. Eastern water dragons (*Physignathus leseurii*) are flighty and can be aggressive as adults. Young lizards of this species may be "hypnotised" by laying them on their backs and gently stroking their abdomens. This is similar to the condition of "tonic immobility" reported in many animals, e.g. chickens.
- Skin tenting, as in mammals, may indicate dehydration.
- Dysecdysis (difficulty with sloughing) can cause constriction or strangulation of digits and the tail tip in some species.
- Mites occur frequently, especially in blue-tongued lizards.
- Abnormalities in muscle tone and posture, fitting and muscle fasciculation may indicate metabolic bone disease (MBD). Lizards may also exhibit hindlimb and tail paresis. Eastern water dragons are more commonly affected and sometimes present as a "neurological" problem. A rubbery mandible occurs in the more chronic form of MBD.
- Examination of the mouth is difficult in many lizard species. Guitar plectra are useful for prying open mouths in skinks and agamids. Nematode infestation of the pharynx occurs

commonly in bearded dragons. Stomatitis presents as swollen and malodorous gingivae.

- Abdominal swelling may occur for a variety of reasons; a full stomach, eggs, tumours and foreign bodies. Agamids, especially smaller ones, may gorge themselves on invertebrates and consequently have a very swollen stomach. Tumours are not common. Eggs may be palpated in the agamidae and easily differentiated from other swellings. Monitor lizards are scavengers and may ingest bone scraps that lead to intestinal or gastric obstruction.

ii. Snakes

- Restraining the head of a python will usually cause it to struggle, whereas if it is handled gently by supporting the body only it will tend to relax. Snakes will excrete voluminous faeces and urates if distressed. Australian pythons, except for the scrub python (*Morelia amethistina*) and water python (*Liasis fuscus*), are usually easy to handle. Venomous snakes should be expertly restrained for the physical examination. It is recommended that only experienced reptile veterinarians examine and treat venomous species.
- Initially the snake should be weighed and its movements closely observed, watching for any unusual coiling, twisting motions or weakness of the distal body and decreased constriction. Flaccidity or any neurological sign in a python, especially *Morelia spp* may indicate Inclusion Body Disease (IBD).
- Snakes with respiratory disease may “mouth breathe”. Gentle and patient palpation is then required for a closer examination. Inspection of the head and mouth should be left as a final procedure as the snake will frequently become distressed when its mouth is opened.
- The snake is a conveniently linear animal and charts have been made to facilitate organ location[2]. The heartbeat (approximately 25% of the snout/vent length [SVL]) can be palpated in debilitated or anaesthetised pythons. It is difficult to feel in a healthy, well muscled snake. Auscultation using a stethoscope is unrewarding.
- The skin will vary in texture and smoothness depending on the state of hydration, ecdysis and external parasitism. Unlike lizards and turtles, healthy snakes shed their skin in one piece. Dysecdysis may be associated with external parasitism or inappropriate humidity.

Common Problems revealed at Physical Examination

i. Lumps in snakes

Lumps occur frequently in snakes for many reasons. Abscesses occur in most parts of the body. Swelling 25% along the snout/vent length in *Morelia spp*. May indicate cardiac enlargement. The author has also seen a case of a fatty tumour in the precardial fat pad causing a similar swelling. Granulomata caused by ascarid infestation are common in the stomach and proximal small intestine. They have a higher incidence in wild caught snakes and those fed live or “wild” prey items. Hypertrophic gastritis due to cryptosporidiosis is mainly seen in elapids and presents as a mid-body swelling. Sparganosis is common in wild caught snakes especially elapids and colubrids (frog eaters). Lesions usually appear as small raised lumps in the subcutis. They occur more commonly in the distal body. Tumours occur but are not common. Prey items and eggs can be detected by patient palpation and good history taking.

ii. Cloacal region

Cloacal infection may occur after mating. The cloaca is usually swollen, inflamed and covered in a crusty discharge. Abscessation of the hemipene sulcus and associated gland may be noted.

iii. Mouth

Oral examination is carried out by holding the head in the right hand (for those who are left handed) and gently pulling down on the ventral skin using the thumb and middle finger to expose the gingivae. A probe may be introduced by the left hand and used to lever the mouth open in order to inspect the glottis and pharynx. Cotton buds should not be used as they catch on the small, delicate teeth.

Stomatitis may be graded as follows:

1. early – petechiation of the gingivae and ptyalism
2. mild – swollen and malodorous gingivae, occasional pockets of pus
3. severe – abscessation and exposure of underlying bone

Check for purulent or cheesy material on the glottis. This may indicate respiratory disease.

iv. Head and eyes

- Inspection of the head and eyes may reveal the presence of mites. They often hide in the periorbital region and the heat sensing pits of pythons. Normally the conjunctivae are not visible. Hypertrophy of the conjunctival tissue is usually a sign of *Ophionyssus natricis* infestation.
- Retained spectacle (post ecdysis) and subspectacular abscess occur commonly.

v. Ecdysis[1]

All reptiles have a periodic sloughing of the superficial, keratinised epithelium. This is termed “ecdysis” and an abnormal slough is called “dysecdysis”.

1. ***Crocodilians:*** These slough small, pieces continually. As the old scales are worn away, they are replaced.

2. ***Snakes:*** These usually slough the skin in one piece, including the spectacles covering each eye. The skin takes on a dull sheen 1-2 weeks prior to ecdysis. The spectacles become a milky blue colour (similar to that seen with keratitis in a mammal) and the snake has poor vision. Many become more flighty or aggressive because of their vision deficit. Most snakes will reuse food at this time. After 4-7 days, the spectacles clear and the slough begins 4-7 days later. The slough begins with the snake rubbing its nose and chin on a rough surface. This dislodges the skin from around the mouth and lips. The snake then crawls out of its sloughed skin, turning it inside out. Snakes that lack a rough surface in their enclosure may have difficulty shedding and will become quite distressed. Dysecdysis is characterised by the skin coming off in pieces and shredding or single scales being shed.

3. ***Lizards:*** These have periodic sheds of large sections of the skin in pieces over several days. They also require a rough surface (log or rock) to rub against to assist in dislodging the skin pieces.

4. ***Chelonians:*** The skin covering the head, neck and limbs is shed in a similar fashion to lizards. The upper epithelium of the scutes of the shell are shed 1-2 at a time and then replaced.

Frequency of ecdysis varies with food availability, species, age, growth rate and ambient temperature in its environment. When the reptiles are eating regularly (Spring, Summer and early Autumn) they grow more quickly and will slough more often – as frequently as once a month.

The skin after a slough, has a shiny, lustrous appearance. This becomes duller as it shows signs of wear and tear.

5. BODY WEIGHT

This is an extremely useful tool in health assessment. The reptile should be placed upon a set of scales (either triple beam balance or small electronic scales) and an accurate measurement taken. I find it useful to place them in a cloth bag during this procedure. This minimises struggling and panic. Objective weight measurement can be used as a regular monitor to assess the reptile and should be recorded on the reptile's file or card. As an in-hospital tool, objective measurement is an excellent prognostic indicator for a reptile receiving treatment. Weight loss is always a sign of a poor prognosis.

As well it is useful to make a subjective assessment of the reptile's general condition after palpating the body wall muscles. With time and experience this can be used to determine the optimum weight for an individual reptile. This is a useful skill for clients to develop as a general health assessment tool.

6. SNOUT: CLOACA MEASURMENT (BODY LENGTH)

A measuring tape should be placed along the ventral aspect of the snake. Determine the distance from the snout to the cloaca. Also determine to distance to any abnormal structures or masses. This is a useful means of locating normal structures and identifying any abnormal masses or structures you may encounter.

Diagnostic Approach to Abnormal Internal masses in Snakes

- Snakes often develop anorexia. On physical examination you may discover an internal mass. This may be difficult to identify as you are uncertain if it is normal or abnormal.
- Common causes: tumours; intestinal impaction; retained eggs or foeti; abscesses or granulomas.

- Snakes organs are elongated and overlap each other as they are distributed along the coelomic cavity.
- The position of most organs is constant within each species as a proportion of the total body length. It is quite variable between species. McCracken[1,2] studied several species of snakes to make a table to allow more accurate determination of normal organ positioning. This is a useful method of determining the source or organ involved in a problem.
- The initial aim is to determine if the mass in intra or extra-intestinal.

History[1]

- How long has the mass been present?
- Any changes in the size of the mass since detected? Impactions should not increase.
- Any other health problems been detected recently?
- Date of last meal and defaecation? Faeces should pass within 1 week of feeding.
- What is the ambient temperature and water availability in its enclosure? Inadequate ambient temperature, humidity and drinking water, following feeding may cause constipation.
- Physical Examination: Are there any other problems present? Is there excess fluid r gas in the GIT.
- Measurement: determine snout-vent length and compare it to snout-mass length (measure to anterior aspect of the mass). Determine the ratio of snout-mass:snout-vent. Compare this to the table developed.
- Palpation: Assess hardness, texture, discreteness and ability to move. If it will advance caudally, it is likely to be in the GIT or oviduct.
- Radiology: Plain radiographs followed by Contrast studies if indicated.
- Initially the mass should be treated as obstipation unless proven otherwise. Deliver paraffin oil via a stomach tube or per rectum depending on the location of the mass. Allow the snake to have a soak in warm water for several hours. Try gentle cheloni to move the mass caudally.
- If there is no movement within 3 days, perform double contrast radiography. Use 5ml/kg barium Sulphate and 45ml/kg air via a stomach tube. If the mass is demonstrated in the GIT but

does not move after 2-3 days more conservative therapy, perform an exploratory coeliotomy.

- If the mass is demonstrated to be outside the GIT, try the following steps:
- Fine needle aspirate
- Check for cryptosporidiosis
- Perform Blood tests to assess the renal system (particularly Uric Acid)
- Endoscopy, via the oesophagus if mass is anterior to the pylorus.
- Perform an exploratory coeliotomy.

As a general Rough guide:

Cranial Third:	Oesophagus, Heart, Trachea
Middle Third:	Lungs, Liver, Stomach, Cranial Air Sac.
Caudal Third:	Pylorus, Duodenum, Intestines, Kidneys, Gonads, Body fat, Cloaca

Organ	**Position (expressed as % of total length snout-vent)**
Heart	22 – 33
Lungs	33 – 45
Air Sac	45 – 65
Liver	38 – 56
Stomach	46 – 67
Intestines	68 – 81
Right Kidney	69 – 77
Left kidney	74 – 82
Colon & Cloaca	81 – 100

7. DETERMINATION OF GENDER

Chelonia

Gender may be determined in most Australian side-necked turtles by physical examination. The tail is longer in males compared with females. The plastron in males is concave caudally. Females have a uniformly flat plastron. The caudal notch of the plastron is more v-shaped in the male. Male chelonian have a single penis.

Squamata

Lizards

Blue-tongued lizards are difficult to sex. Exteriorisation of the hemipenes is possible by an experienced operator[6]. Male bearded dragons have two hemipene bulges either side of the ventral tail base just caudal to the cloaca. Females have a midline swelling. Male water dragons and other larger agamids have prominent femoral pores on the medial femoral skin, similar to iguanas. Radiography of mature male varanids (monitors) detects small ossifications of both hemipenes. Absence of this feature may indicate a female or immature male.

Snakes

Tail shape and the prominence of spurs (vestigial hindlimbs) are sometimes used to determine the sex of snakes. Probing of the hemipene sulci just caudal to the cloaca is a more accurate method. A variety of probes, ranging from commercially available products to nasolacrimal catheters (metal) and crop needles are useful. Snakes should only be probed for diagnostic, commercial or breeding reasons. The procedure may be traumatic and inaccurate in young animals.

Probing Method

Two handlers are required for larger snakes. One person holds the front end and the other person holds the distal end “belly up” with one hand about 10 cms cranial to the cloaca. Gently introduce the sterilised (alcohol will do) and lubricated probe into one of the hemipene sulci `which run down either side of the tail. Males – probe – 10-12 subcaudal scales. Females – probe – 4 subcaudal scales. These lengths are only estimates. Probing depths may vary for different species eg` *`Morelia amethistina`*`, the female has deep pockets, 6-8 scales.`

8. BASIC DIAGNOSTIC PROCEDURES

The focus for this section is on procedures rather than different diagnostic tests and laboratory analysis (i.e. histopathology, haematology, biochemistry).

8.1 Blood collection (and intravenous injection sites)

Chelonia

In most side-necked turtles the left jugular vein is used. The subcarapacial method[7] has also been described but is not used commonly.

Squamata

The ventral caudal tail vein is used for bleeding and intravenous injection in most lizards (skinks, dragons, monitors). This route is also commonly used in snakes. Blood collection by cardiac puncture and the palatine veins (large pythons) has also been described,[8,9] but is not recommended by the author in conscious animals. The heart is often difficult to locate in snakes. In most cases a one millilitre tuberculin syringe and 25 gauge needle are adequate for venipuncture. A three millilitre syringe and 23 gauge needle may be used in pythons larger than 3 kg and large monitors.

8.2 Cloacal wash

A small amount of warm saline may be introduced into the cloaca to obtain a diagnostic sample. Protozoa and the ova of other endoparasites may be detected by direct faecal analysis.

8.3 Tracheal wash

A transtracheal aspirate is useful for microbiological and cytological analysis in cases of respiratory disease. The glottis in turtles, snakes and monitors is conveniently situated in the rostral part of the mouth. The technique is identical to that used in small mammal medicine.

8.4 Radiology

Radiology is a useful diagnostic aid. For example, it is essential for gender determination in varanidae, assessing gravid turtles and MBD in lizards. The latter may be graded over the course of treatment using a step wedge device (PT-11 Penetrometer [Eseco-Speedmaster, Oklahoma]). Fractures of the carapace, plastron and limbs in chelonia and limb fractures in lizards are also routinely radiographed. Fine detail mammography film is useful in small reptiles.

8.5 Other

Ultrasound, computerised tomography and MRI are used in the USA, UK and Europe as diagnostic tools to varying degrees. Their usefulness appears limited in everyday reptile practice.

8.6 Endoscopy

Endoscopy is commonly used in reptile practice in the USA and UK, especially in iguanas and increasingly in chelonia. Previously endoscopy was used mainly as a diagnostic tool to examine and biopsy internal organs but recently it has been used for local, targeted medical therapy and minimally invasive surgical procedures.[10] In Australia where snakes are more popular, there appears to be less demand for endoscopy. Palpation, transcutaneous biopsy and coeliotomy are more commonly used for diagnostic purposes.

SUMMARY

Physical examination and diagnosis in reptiles can be challenging, physically and intellectually. First principles from mammalian veterinary practice are easily adapted to the class Reptilia. Extensive knowledge of the normal animal is essential in order to recognise the abnormal.

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Chapter 3

Clinical Examination – Small Mammals

Dr Michael Cannon

RODENTS

The order Rodentia is divided into two major suborders:

- Hystricomorph (porcupine like rodents, includes Guinea Pigs)
- Sciurognathi (include rats and mice)

There are a rapidly increasing number of people in Australia who keep rats, mice and guinea pigs (also called cavy) as pets. As a veterinarian in companion animal practice, you need to be able to confidently and thoroughly examine and medicate these animals. An understanding of husbandry as well as common clinical techniques and diseases is important part of this process.

Clinical Examination of Rodents

You need a different approach when examining a rodent, compared to the more usual cat and dog, because of their unique anatomy and physiology. Many of the problems we see are a direct result of inappropriate husbandry and/or diet because of the fact that this is not well understood by owners or staff in pet shops and similar.

The components of a Clinical Examination you should cover are:

1. **History**
2. **Distant Examination**
3. **Physical Examination.**

1. History

When examining one of the rodents, you need to uncover a more detailed history than you would for cats and dogs. Some experienced vets like to have the client arrive early to fill in a detailed history questionnaire prior to the consultation. I prefer to do this while speaking directly to the owner. When a client makes an appointment, our receptionist will recommend they bring in a fresh faecal sample for us to examine.

Obtaining a thorough history is the basis of a successful examination process.

History components you need to cover include:

- Age, breed, gender, any other cage mates or pets that mix with this one
- Date & place of acquisition
- A detailed list of diet components
- Details of the housing
    - Size
    - Supplemental Heat
    - Bedding/Substrate used
    - Cleaning regime
- How often cage cleaned?
- Diet – components? Treats?
- Previous medical problems.
- Tests performed previously
    - Faecal/Bloods/0ther
- Outline of current problem:
    - How long?
    - Improving/same/worse?
- Medications
    - Formulation
    - Dose
    - Delivery

The advantage in obtaining a detailed history prior to the examination, id that it allows you to examine it prior to talking to your client and avoids you making mistakes such as incorrect breed or gender identification – that makes you look less competent. The advantage of collecting the information when speaking to a client is that you can explore any important areas you identify in more detail ands with more immediacy. I also find that for many clients this is their first contact with a vet and for reasons I am unable to identify, they resent filling out all the information as they see it as a waste of their time – this can be overcome with well trained reception staff. In my practice, I found that asking clients to fill out a thorough history form led to resentment before I had had a chance to speak directly to the client and was a poor way to begin our relationship. You need to find the balance that works best for your practice.

2. Distant Examination

As soon as you enter the consultation room and meet the pet and the client, you should be discussing the history, but also take time to observe as much as you can before you reach over and restrain the pet.

The client is anxious for you to pick up their pet and examine it. You need to explain why you are spending time talking and observing.

When you have discussed the history, you should be developing a provisional differential diagnosis.

Now it is time for the patient to come out of its transport cage. I recommend you do not pick up the pet, but ask the owner to do so. This is less stressful for the animal and is also a good check of how the animal is used to being handled as well as the owner’s level of competence.

Ask the client to place the pet on the consultation table and quietly continue your observations. Answer the following questions:

- How has the pet responded to being handled?
- Is the pet alert and responsive to its surroundings?
- Note respiratory rate and depth
- Any signs of discomfort?
- Any obvious external lesions?

Once you have answered these questions, it is time to begin your physical examination. Only after quiet observation of the animal would I advise you to pick up the pet & begin your hands on clinical examination.

3. Physical Examination

This part is not greatly different to what you would perform on a dog or cat. The major complicating factor is that theses animals are extremely prone to stress. Be quiet and move slowly but use first principles – examine each body system as you would routinely with a dog or cat. I do not routinely collect temperatures with a rectal thermometer as it creates too much stress.

Rats and Mice

Rats and mice belong to the suborder *Sciurognathi* of the order *Rodentia*. They share a common family – *Muridae*.

Rats and mice make very good pets for children. If they are raised from a young age with children, they easily adapt to being handled and the risk of them biting is minimal. Children enjoy watching them perform their natural behaviours during their daily active periods. Rodents raised in captivity do not display the nocturnal habits of wild rodents but can be active both day and night – especially mice.

Rats (*Rattus norvegidus* or Brown Rat)

Normal data:

- Adult Weight: **Male 265-500g; Female 225-325g**
- Average life span: **2 .5—3.5 Years**
- Rectal Temp **36-37.5C**
- RR **70-150;**
- HR **250-450**
- Tidal Volume: 0.6-2 ml
- Blood Volume: 55-70 ml/Kg
- Blood Pressure: 84-134/60 (systolic/diastolic)
- Water consumption: 100-120 ml/Kg/day
- Food consumption: 100 g/Kg/day
- Urine production: 13-23 ml/day
- GIT Transit time 12-24 hr.
- Dentition: **2(I1/1 C0/0 P0/0 M3/3)**

Reproductive data:

- Sexual Maturity: **Male 6-10 weeks; Female 8-12 Weeks**
- Oestrus cycle **4-5 days, oestrus for 14 hours, year round**
- Gestation **20-23 Days**
- Litter Size **6-18 (10 Average); 4-7g birth weight;**
- Eyes open: **12-15 days, eat solids from day 14**
- Wean from **21 days - 40-50g**

Mice (Mus musculus)

Normal data:

- Adult Weight: **Male 20-40g Female 25-63g**
- Average Life Span: **1.5- 2.5 Years**
- Rectal Temp **36.5-38 oC**
- RR **60-220**
- HR **350-750**
- Tidal Volume: 0.09-0.23 ml
- Blood Volume: 75-80 ml/Kg
- Water consumption: 150 ml/Kg/day
- Food consumption: 150 g/Kg/day
- Urine production: 0.5-2.5 ml/day
- GIT Transit time 8-14 hr
- Dentition: **2(I1/1 C0/0 P0/0 M3/3)**

Reproductive data:

- Sexual Maturity: **Male 6-8 weeks; Female 6-8 Weeks**
- Oestrus cycle **4-5 days, oestrus for 14 hours, year round**
- Gestation **19-21 Days**
- Litter Size **6-12 (8 Ave); 1-1.5g birth weight;**
- Eyes Open: **12-14 days, eat solids from day 12**
- Wean from **18-21 Days, 10-12g**

Most pet rats belong to the species *Rattus norvegicus.* If raised with humans from an early age they socialise well and rarely bite or scratch. They make ideal pets for children as they are small but large enough to be handled easily. Many rats recognise their owners and can be trained to come for treats.

The key to a friendly rat is early socialisation with humans.

Rats are much more active at night than are mice. While adult male and female rats can cohabitate, it is not recommended to introduce adult males together as they can be quite aggressive.

Rats come in several colours and varieties including:

- Albino (white with red eyes, prone to poor vision),
- Agouti (common brown colour)
- Silver
- Rex
- Hooded (different head colour)
- Self (one solid colour).

Diet

Rodents are omnivorous herbivores so the most appropriate diets for pet rats and mice is a commercial rat or mouse pellet and as many different vegetables as they will eat (aim for vegetables to comprise 20-30% of diet). Most commercial rat pellets have a fat content of 4-5% and a protein level of 16%. Laboratory pellets should not be offered ad libitum but controlled to maintain good condition and avoid obesity.

Vegetables commonly offered: broccoli, cabbage, Brussels sprouts, endive, carrots, Bok Choy or other Asian greens, celery, parsley, berries, beans, peas. This can be supplemented with small amounts of fruit: apples, pears, banana, melons, citrus fruits, stone fruits, berries tomato.

Some owners like to feed rats birdseed but this is not recommended other than in small amounts as a treat, because the fat content of seeds is too high for rodents - most common seeds range from 22-50% fat content.

The most common problem seen with diets is that the rats become obese as they over-eat fatty foods and under-exercise. Treats (cake, bread, chocolate, seed sticks) should be fed in very small volumes or preferably discourage clients from feeding any treats at all.

Housing

A more thorough outline of husbandry for rats and mice can be found in: Brown CJ, Donnelly TM. 2004. Rodent husbandry and care. *Vet Clin N Am. Exot Anim Pract. 7(2):201-225.*

Many commercial prefabricated housing enclosures are available from pet shops. When recommending one to a client, emphasise that it must be easy to dismantle for thorough cleaning but also has good ventilation. Rats have an undeserved reputation for being dirty and smelly – in most cases the problem is that the client is not cleaning the enclosure frequently. The build up of ammonia from the rat's urine can be overpowering and so cleaning should be done frequently enough so that this odour is minimised.

Enclosure Specifications (after Brown & Donnelly)

	Rats	**Mice**
Minimum Floor Space	152 cm^2	38 cm^2
Minimum Cage Height	38 cm	20cm
Enclosure Flooring	Solid, avoid wire floors	Solid, avoid wire floors
Temperature Range	18-26 ^{o}C	18-26 ^{o}C
Relative Humidity Range	30-70%	30-70%

Choose bedding carefully. It should be dust-free, absorbent and non-toxic. Provide a depth of 3-4 cm in most cases. Bedding should be changed daily. Commonly used bedding materials include:

- Wood shavings (avoid aromatic shavings or wood treated with copper arsenate etc.)
- Processed corn cobs
- Soft Tissue paper
- Shredded paper

- Paper Pellets - Kitty litter made from recycled newspaper (e.g Breeders Choice ®)

A good combination is a bedding of kitty litter (recycled newspaper) with added shredded paper for nesting material

Handling and Restraint of Mice & Rats

How pet rodents are handled will determine how friendly they become. Be calm and gentle and they respond well. Always assess the rodent's body language and progress slowly if the display and signs of being frightened or nervous. Avoid handling an animal that is asleep as they can be unpredictable when suddenly awoken.

Mice are gregarious animals and if kept in a group are more likely to be calm than those that are raised alone.

If you have been handling other animals (dogs, cats, reptiles etc.) prior to handling the rat or mouse, thoroughly wash your hands to remove the threatening odours of predator animals.

The easiest way to restrain rats and mice is to progress quietly and with a calm manner. Allow them to smell your hands initially. Encourage them to walk onto your hands and then scoop them into your hands held in a cup shape. Use your hands to support their thorax and hindlegs. Take them a way from their cage to a neutral area as they are much easier to handle when not in their usual environment.

For nervous or territorial animals, ask the owner to remove the pet from the cage. A stranger attempting to remove some territorial animals can exacerbate aggressive tendencies.

Mice can also be handled by grasping the base of their tail. Rats are more easily damaged this way because of their larger weight, so this is not recommended for them. The correct method is to grasp the tail closer to the tail base, rather than near the tip - as degloving of the skin at the tail tip can easily occur.

For examination, mice can also be restrained by grasping the tail with your dominant hand and placing the mouse on a rough surface so it attempts to run away from you – extending it body and neck. This allows you to use the thumb and forefinger of your other hand to grasp the scruff of the neck, close to the base of the head. This should reduce the ability of the mouse to turn its head and bite you. Place the tail between the last two fingers of the hand holding the scruff and this comfortably restrains the mouse as well as providing you with your dominant hand free to perform an examination.

For examination, rats are restrained by placing your non-dominant hand over the dorsal aspect of the thoracic spine and ribs and using the thumb and forefinger to retrain around the head and neck. In some cases it is necessary to grasp the tail with your dominant hand and allow the rat to extend it body and head/neck, prior to restraining the rat as described above.

Rats are also gregarious but more prone to fights and disputes. Pets can be housed in groups of individually. In many case aggression is driven by disputes over feeding or drinking sites so multiple food and water sites should be provided.

Reproduction for Rats and Mice

Gender determination: With rats and mice it is easy to determine gender, even in neonatal animals, because of the significant difference in ano-gential distance – the distance between the anus and the opening of genital orifice. Males have the opening of the prepuce and the anus at approximately twice the distance compared to the females between the anus and vulva. Adult males have a prominent scrotum and testes. Only females possess nipples – in 2 rows on caudo-ventral abdomen.

Rodents need to be in compatible pairs or fighting will occur. Mice can be maintained in pairs or trios of 1 male and 1-2 females. If more males are present fighting is likely. Male Rats are more tolerant of each other and can be kept in mixed groups of both males and females.

Mice

Females are sexually mature at approximately 50 days old (8 weeks). The oestrous cycle occurs throughout the year. They are receptive to the male for 12 hours (usually at night) each 4-5 days until they are pregnant. Females come back into receptivity and fertile oestrus within 24 hours of delivering a litter of 10-12 babies (young and older females have smaller litters).

Gestation in mice lasts approximately 3 weeks, but can be up to ten days longer if the pregnant female is also nursing a litter.

Encourage owners to avoid handling members of a litter for 3-4 days after birth to avoid the mother abandoning the litter.

Weaning occurs around 3 weeks of age.

Rats

Females are sexually mature at approximately 65 days old (9 weeks). The biology of oestrus is similar to mice: The oestrous cycle occurs throughout the year. They are receptive to the male for 12 hours (usually at night) each 4-5 days until they are pregnant. Females come back into receptivity and fertile oestrus within 48 hours of delivering a litter of 6-12 babies (young and older females have smaller litters). Unlike mice, it is recommended that the male be removed from the enclosure prior to delivery of a litter as they may injure the pups, so they are usually not present to take advantage of the post-partum oestrus.

Gestation in rats is approximately 3 weeks. Similar to mice, the he female and her litter should not be disturbed for the first few days after birth, because a stressed female rat may injure or kill her pups.

Weaning occurs around 3 weeks of age. The female will returns to her normal oestrous cycle 2-5 days after the young are weaned.

Clinical Examination of Guinea Pigs

- Clinical examination of guinea pigs is difficult because they are so easily stressed and vocalise loudly – warn clients this will happen
- Monitor them closely on the examination table as they are prone to walking off the edge if not adequately restrained!
- Examination of the mouth is impossible without sedation or anaesthesia.

As with rats and mice, the literature contains many different anaesthetic regimes for rats & mice. The comments for rats and mice above hold true for guinea pigs.

- I do not routinely fast prior to anaesthesia as rodents have difficulty vomiting so it is not an important risk factor as with cats and dogs. In many cases they have food removed 2-3 hours prior to anaesthesia so there is no food particles present in the oral cavity.
- There is a large range of recommended premedication agents.
    - I prefer Midazolam (1-2mg/kg IM).+ Butorphanol (1-2mg/kg SC).
    - Another successful combination is Acepromazine (0.5-1mg/kg) + Buprenorphine (0.05-1mg/kg)
- Induction with isoflurane via mask or in an induction chamber
    - Consider pre-oxygenation for several minutes.
    - Maintain on 1.5-3.5%.
- Control heat loss.
    - Use heat pads, bubble-wrap or heated air.
    - Minimise clipping or overuse of skin disinfectants.
- Monitor
    - RR & HR.
    - If possible, use a Doppler for heart rate & rhythm.
- I prefer to avoid injectable anaesthetics. Many authors recommend their use.
- Use careful surgical technique to minimise haemorrhage and blood loss.
    - Handle tissues gently and carefully
    - Use subcuticular skin sutures + tissue glue, so no protruding sutures they can chew and remove
- Recovery
    - Maintain use of heat pad or place in heated enclosure
- Keep isolated from cage mates for 7-10 days to avoid any excessive exercise and wound breakdown.

CLINICAL EXAMINATION OF RABBITS

Overview

Rabbits are a very common pet in Australia and overseas. There are approximately 70 different rabbit breeds recognised in UK and 42 different rabbit breeds in USA, available as pets or show animals.

Popular pet breeds:

- New Zealand white
- Angora,
- Dwarf breeds
    - Netherlands Dwarf
    - Lop-ear (have pendulous ears rather than the usual erect ear)
    - Mini Rex.

In all states and territories of Australia, wild rabbits are legally considered vermin – in Queensland there are fines up to $5,000 for having a pet rabbit.

Rabbits belong to the Order *Lagomorpha*, family *Leporidae*. They close relatives of rodents but differ in that rabbits have a second pair of upper incisors – commonly referred to as ‘peg teeth’.

Male rabbits are called ‘bucks’, females are called ‘does’ and young are called ‘kits’.

Rabbits have been domesticated since the Roman Empire and are gentle, quiet animals that make excellent pets. Most rabbits respond well to human interaction and recognise and/or bond to individuals.

Rabbits are true herbivores and in the wild spend much of the day in burrows, emerging to forage at dawn and dusk. They like to explore, but also to chew, so it is important to guard against inquisitive nibbling when they are allowed to roam around the house—watch electrical cords, furniture and any wooden items!

It is important to provide a stimulating environment for rabbits, with items such as toys. These may be as simple as cardboard boxes or tubes, toilet roll or paper towel inserts, branches from fallen trees or wooden toys designed for parrots.

Handling

Care must be used when handling a rabbit, the hindlegs and spine should be supported when they are removed from their cage. Their hindlegs are so strong that if they suddenly kick out, explosively, with their hindlegs they can damage their spine.

Rabbits can be extremely gentle with owners and people they recognise but may kick, bite or scratch if frightened.

Sexing

- Older males easily animals sexed by detecting the well developed scrotal sacs & testes.
- Sexing can be a challenge in very immature animals
    - Vulval orifice is elliptical
    - Preputial orifice is circular & the anogenital distance is longer in males
    - Gently place a forefinger & thumb on either side of the orifice & press
- Males you will extrude the circular tip of the penis
- Females a ‘V’ shaped vulva is protruded

Biology

- Weight: 900g—6kg (depending on breed)
- Sexual Maturity: Male 4-7 months, Female 4-9 months (Dwarf breeds younger)
- Puberty: approximately 12 weeks so separate sexes at 10 weeks of age!
- Average life span: 6-8 years (Max 15)
- Gestation period is 30-33 days
- Does can mate soon after giving birth
- Litter size averages 5-8
    - NB. doe places the young in a nest and only returns to feed for several minutes (sometimes only 2-3) once or twice daily during which time the young can drink up to 20% of their bodyweight.

    - Clients often telephone the clinic to state the doe has ‘abandoned’ its young.
    - Eyes are open at 7 days
    - Young emerge from the nest at around 18 days
    - Commence eating vegetable matter at 3 weeks
    - Weaned at 4-6 weeks.
- Rabbits are a social species
    - Benefit from companionship
    - Preferably kept as a bonded pair
    - Some pairs will bond for life & become inseparable
    - Desexing is strongly recommended
    - A single rabbit kept as a pet and is more likely to bond to its owner.

Housing

The traditional cramped box-like hutch with wire flooring is unsuitable for pet rabbits. It causes foot, spinal and behavioural problems.

The ideal hutch:

- Provides relief from extremes of temperature, wind and rain
- Is well ventilated yet minimises the risk of exposure to pathogens such as mosquitoes or fleas
- Provides a hide and/or sleeping area
- Has a run to allow free movement & exposure to natural light
- Does not have wire flooring
- Has sufficient hay or straw for bedding that is changed regularly
- Has a litter tray or corner for toileting
- Is easily cleaned and is cleaned regularly (ideally daily)
- Includes various furniture or toys for behavioural enrichment

It cannot be overemphasised that confining a rabbit to a hutch for long periods is bad!

Exercise

All pet rabbits MUST have daily exercise outside of the hutch.

  - Recommend at least 4 hours free roam exercise daily
  - Preferably outdoors with exposure to unfiltered light

Exercise

- Promotes a healthy GIT
- prevents obesity & spinal concerns
- Promoting adequate skeletal strength and muscular tone
- Prevents behavioural problems
- Rabbits constantly in a cage exhibit many behavioural problems such as obsessive grooming, aggression, lethargy and chewing of cage bars.

History & Clinical Examination of the Rabbit

You need to modify your approach to examining a rabbit, or any other unusual or exotic pet because of their unique biology. The emphasis of poor husbandry and diet as factors in many diseases and the poor general knowledge of clients of the health care of unusual or exotic pets.

History

A detailed history is crucial when dealing with rabbits. Some vets ask all owners to fill in a detailed history sheet before consultation. There are samples of these history forms on the UEP Yahoo website for free use/modification of members: UnusualExoticPets@yahoogroups.com

It is also worthwhile asking owners at the time of booking to bring a faecal sample of their pet for examination.

Since a large percentage of problems in these pets are related to inadequate husbandry, this is the focus of much of the history.

Information you need to obtain from the owner includes:

- Age, breed, sex, any other cage mates
- Date & place of acquisition
- A detailed breakdown of diet
- Details of the housing – how big? Heating? Substrate? Cleaning?
- Previous medical problems. Routine screens (faecal, bloods) done?
- Outline of current problem: how long? Better/same/worse?
- Medications

If you are new to these animals, there is also a benefit in having your nurse collect the history prior to the consultation. You have an opportunity to examine the history before entering the consultation – this enables you to avoid making blunders like naming the wrong breed, sex or colouration of animal. You don't need to be an expert on breeds etc. – get the client to inform you before the consultation!

Distant Observation

Spend some time reviewing the history with the owner once they enter the consultation room, you can also observe the rabbit and how it is responding etc in its transport cage. DO NOT pick up the patient yet! I prefer to ask the *owner to remove the animal* from the transport cage and place it on your exam table.

Take time to observe the animal:

- Is it alert and aware of its surroundings?
- What is the respiration like?
- Does it seem in discomfort?
- Can you see any obvious external lesions?
- Rabbits, being a 'prey' species can often 'freeze' in a consultation, making detailed clinical examination difficult.
- Consider booking in rabbits & rodents together, to avoid a stressed rabbit sitting next to a cat or dog in the waiting room.

Only after quiet observation of the animal should you to pick up the pet & begin your hands on clinical examination.

This allows you to pick up subtle abnormalities in the pet before handling stress occurs, but it also allows you to assess the skills of the client: does she seem confident handling the animal? Does it look like she handles this pet often?

Hands on Clinical Examination

- Perform a systematic examination of the rabbit as you would for a dog or cat.
- Stressed animals will be more difficult to examine.
- If you are uncertain regarding normal or abnormal features, don't panic - Go back to first principles – stop, think, be systematic!
- Do not routinely take rectal temperatures for most small mammals
    - Most rabbits are amenable to rectal temperature recording.
    - Sitting the rabbit on its backside with the perineum uppermost, head resting in my lap.
    - Rabbits pave a wide rectal temperature range of rabbits: 38-5 – 40C.
    - Concern only if temperature is <38C or > 40.5C.
- Always support the hindquarters when carrying a rabbit.
    - Rabbits have a fragile skeleton (7-8% of body weight compared with 13% for cats).
    - Tuck the rabbit into my body when carrying.
    - Place rabbit on a towel or other non slip surface on the examination table.
- Systematically examine all body systems as you would for the clinical examination of a dog or cat.
- Palpate the ventral mandibles for signs of bony lumps which are often present with dental disease.
- Mouth is difficult to examine without sedation or anaesthesia

Blood Collection

- Most veterinarians prefer jugular venipuncture.
- Alternative venipuncture sites
    - Lateral (marginal or caudal auricular) ear vein
        - Be careful not to catheterise the central ear artery which may then result in subsequent sloughing of the ear.
    - Lateral saphenous vein
    - Femoral vein. My preferred blood collection method is a ‘blind’ technique at the entrance to the thoracic cavity. The rabbit is anaesthetised & a 25 gauge needle & 3ml syringe is used. The site of collection is at the sternal notch & the needle is angled at 30-45 degrees aiming to the contralateral femur. This will allow collection of blood from the jugular as it passes the thoracic cavity entrance. It is a very easy & repeatable technique to master.

Fluid therapy can be difficult in depressed or moribund rabbits.

Possible IV sites

- Marginal ear vein (caudal auricular vein)
- Using a 21-25 gauge butterfly catheter that is glued to the ear
- EMLA anaesthetic cream can aid with avoiding rabbit movement during placement.
- Intraosseous fluid therapy is an alternative
    - proximal humerus
    - tibial crest
    - proximal femur

Feeding

The most common cause of gastrointestinal disease in rabbits is poor diet. There are a large variety of rabbit foods available in pet shops and supermarkets, most, if not all of which are inappropriate for pet rabbits.

See notes in Common rabbit problems for more detail on feeding rabbits.

CLINICAL EXAMINATION OF FERRETS

Ferrets are popular pets. They are extremely challenging because they are very inquisitive and intelligent. Most enjoy interacting with people – especially their owners.

Male ferrets are called hobs, females are called jills and the young are called kits.

Many people mistake ferrets as a member of the rodent family. They are carnivores – *Mustela putorius furo*., from family *Mustelidae*. Their closest relatives are weasels, stoats, mink, otters, badgers, skunks etc. The domestic ferret is descended from the polecat and was originally raised to hunt rodents & rabbits. There is an endangered member of the ferret family - the black-footed ferret of North America. Ferrets have been used for hunting for over 2000 years, they are still used for hunting rabbits in Australia.

Colour variations:

- Normal wild type = sable or 'Fitch' (yellow with black guard hairs)
- Albino (white with red eyes)
- Cinnamon. (beige colour)
- Many other colours
    - Black eyed white (albino with black eyes)
    - Silver mitt (sable with white chest and feet)
    - Siamese (overall medium brown)
    - Panda (white head and neck, body any colour)

Biology

- Weight: Male 1-2 kg; Female 0.5—1 kg
- Sexual Maturity: 4-8 months
- Gestation: 41-43 days
- Litter size: usually 8-10 kits (can be 1-18)
- Eyes open: 30-35 days
- Weaned: 6-8 weeks (handle daily from 4 weeks to encourage tameness)
- Dentition: Deciduous erupt weeks 3-4, Permanent 47-74 days.
    - Deciduous: 2 x (I4/3, C 1/1, PM 3/3, M 0/0)
    - Permanent: 2 x (I3/3, C 1/1, PM 3/3, M1/2)
- Average life span: 5-8 years

Husbandry

The key to a healthy ferret is good husbandry.

Enclosure

- Largest cage that will fit in the space available
- Provide several levels in cage, with connecting tunnels, ladders & other furniture.
  - PVC plumbing pipes make excellent tunnels and are easy to clean.
- Supervised play outside the cage is essential to avoid boredom and help with human socialisation.
- Chewing is a problem causing intestinal obstruction so a daily check to assess what has been chewed is recommended.
- Litter trays in every room that the ferret accesses.
- Litter tray substrate
  - Shredded paper products or recycled newspaper cat litter (e.g. Breeders Choice®).
  - Avoid wood shavings as they can contain resins or allergens that may cause respiratory irritation.

Diet

Ferrets have a very high metabolic rate and should have food and fresh water always available. Water bottles are less messy and therefore preferred to water dishes. Have at least 2 water supplies in case one becomes blocked or tipped over.

- Ferrets are true carnivores; their diet must consist mainly of meat and animal products.
- Unable to digest diets high in fibre or carbohydrates
- Commercial ferret diets, formulated to meet the specific nutritional needs of the ferret, are slowly becoming available in Australia.
- The best alternative to a ferret diet is a premium quality dry kitten food.
  - Hill's Science Diet Kitten dry food.
  - IAMS Kitten or Advance Kitten DRY foods.
- Ferrets enjoy some fruits, vegetables, and other treats.
  - fed in moderation
  - excess consumption may result in diarrhoea and create finicky eaters.
- Offer a small raw meaty bone weekly to help prevent dental disease

Preventive Health Care

- Vaccination: Canine Distemper
    - Under 14 weeks require 2 vaccinations
    - Use 1/3 – 1/5 of a C3 vaccine.
    - For most vaccines, this is ‘off label’ use
    - Distemper is fatal in ferrets
    - Annual booster is recommended.
- Intestinal parasites are not a common problem in ferrets
    - Annual faecal examination for intestinal parasites
    - Repeat annually or if any signs of illness.
- Quarantine all new ferrets
    - at least 4 weeks before being introduced to other ferrets
- Heartworm disease.
    - Clinical Signs:
        - Heavy and laboured breathing
        - Sudden death.
    - Monthly heartworm preventative*:*
        - Selamectin (Revolution®)
        - also covers flea infestations and some intestinal parasites
        - good for sarcoptic mange
        - Could also use Heartgard®
        - Very palatable
    - Annual physical exam is recommended
        - Consider twice yearly for ferrets over 3 years of age
        - Four years age
            - Radiographs and CBC/Biochem each 6-12 months
            - Aim to detect early signs of diseases such as lymphoma, cardiomyopathy & splenomegaly which are relatively common in aged ferrets.

Summary preventative health points

- High protein diet – top quality kitten dry food
- Distemper Vaccination
- Heartworm prevention
- Spay females

Clinical Examination Techniques

- Ferrets are very alert & inquisitive animals and need to be handled carefully
  - It is often best first to have the owner handle the ferret whilst you observe from a distance
- Most ferrets are used to being handled and rarely bite (although a testing ‘nip’ is not unusual).
- Use minimal restraint
- Scruffing high up near the base of the skull is used for firmer restraint. Clinical examination is similar to that of dogs & cats. Note the very caudal location of the heart. I do not routinely check rectal temperatures in apparently healthy ferrets. The recorded normal rectal temperature range for ferrets is wide: 37.5-40C. Sexing ferrets is straightforward - the ano-genital distance is much larger in the male.
- Blood sampling can be difficult in conscious patients.
  - Some texts have the ferret restrained like a cat for jugular sampling – head arched back & held at the edge of the table by a nurse – this is usually not possible in my experience
  - I use general anaesthesia with isoflurane for blood sampling
  - Collection sites:
    - Vena Cava
    - Cephalic Vein
    - Saphenous veins
    - Cardiac puncture is not recommended

RAT FACT SHEET

Life span	2.5-3.5 years
Weight	Male 265-500g; Female 225-325g
Sexual Maturity	Females 6-10 weeks & Males at 8-12 weeks
Ovulation	Oestrus every 4-5 days, oestrus lasts 14 hours
Gestation	3 weeks (20-23 days)
Litter Size	6-18 (average 10)
Birthweight	4-7g
Eyes open	12-15d (eat solids from day 14)
Weaning	21 days (40-50g)
Nursing	Do not disturb mother in first few days
Dental Formula	2(I 1/1 C 0/0 P 0/0 M 3/3)
Temp	36-37.5C (Ideal temp range 21-24C, 45-55% Humidity)
HR	250-450
RR	70-150

Food	15-20g daily
GI Transit	hours
Hard Faeces	9-15g/day
Water	10mls/10g daily/ 22-33ml/day
Urine	13-23ml/day

Blood collection

Blood Volume	Approx 55-70ml/kg = 21-35ml
Safe sample volume	2.4-4ml
Collection sites	Lateral tail vein, ventral tail artery, saphenous vein. Cardiac puncture & orbital venous plexus?

Urinalysis

Volume	13 - 23 ml/day

Haematology

PCV	0.54 – 0.85
RCC ($x10^6$)	5.4 – 8.5
Haemoglobin	11.5 – 16.0 g/Dl
WCC ($x10^3$)	4 – 10.2

Fibroadenoma is most common s/c tumour (adenocarcinomas fewer than 10%)
(c.f. mice: adenocarcinomas, followed by fibrosarcomas)

MOUSE FACT SHEET

Life span	up to 3 years (average = 1.5-2.5 years)
Weight	Male 20-40g; female 25-63g
Sexual Maturity	Females 6-8 weeks & males at 6-8 weeks
Ovulation	Oestrus every 4-5 days, 9-20 hours duration (average 14 hours)
Gestation	19-21days
Litter Size	6-12 (average 8)
Birthweight	1-1.5g
Eyes open	12-14 days (eat solids from day 12)
Weaning	18-21 days (10-12g)
Dental Formula	2(I 1/1 C 0/0 P 0/0 M 3/3)

Temp	36.5-38.0 ^{o}C (ideal temp range 24-25C, 45-55% humidity)
HR	350-750
RR	60-220

Food	3-5g daily
Hard Faeces	1-1.5g/day
Water	*5-8mls/day/adult*
Urine	1-2ml/day

Blood collection

Blood volume:	approx 75-80ml/kg = 2-3.2ml.
Safe sample volume:	0.2-0.32ml
Collection sites:	Lateral tail vein & Saphenous vein. Cardiac puncture & orbital venous plexus?

Haematology

PCV	0.37 – 0.46
RCC (x10^6)	7.9-10.1
Haemoglobin	11.5 – 16.0 g/Dl
WCC (x10^3)	5.0-13.7

GUINEA PIG FACT SHEET

Lifespan	5-9 years (Average 5-6 years)
Weight	Males 900-1200g; females 700-900g
Sexual maturity	Females 2-3 months; Males 3-4 months
Oestrous	15-17 days; nonseasonally polyoestrus
Ovulation	Spontaneous
Gestation	Average 68 days (59-72)
Postpartum oestrous	12-15 hours after littering
Litter Size	1-13 (usually 2-4)
Birth weight	70-100g
Weaning	21 days (180g)
Dental Formula	2(I 1/1 C 0/0 P 1/1 M 3/3)

Temp	36.5-39.5 °C
HR	240-310
RR	40-100

Blood Collection

Difficult in many cases

- Cephalic/lateral saphenous: 25G or smaller needle. Often difficult.
- Jugular: Similar to cat.
    - Often need to sedate or general anaesthesia.
    - Use anaesthesia, collect similar to ferrets

Lymphosarcoma most common tumour.

- Scruffy coat & peripheral lymphadenopathy
- WCC usually 25,000-500,000/uL

Dystocia: problem with pelvic symphysis fusion if not bred early (< 7 months)

RABBIT FACT SHEET

Life span	6-15 years
Weight	Buck 2-5kg; Doe 2-6kg (varies with breed up to 10kg)
Sexual Maturity	4-10 months puberty at 12 weeks Recommend separate sexes at 10 weeks 2 uterine horns opening into vagina (2 cervices)
Ovulation	Induced, approx 10hrs after copulation, prolonged oestrus
Gestation	30-33 days
Pseudopregnancy	16-18 days
Litter Size	4-12 kits, Ave 5-8
Birth weight	30-100g
Weaning	4-6 weeks
Nursing	Once daily for few minutes
Dental Formula	2(I 2/1 C 0/0 P 3/2 M 3/3)

Temp	38.5-40C
HR	130-325
RR	30-60

Diet	Need high fibre (>20% for adults)
GI Transit	4-5 hours (caecotrophs)
GI Transit	8-9 hours (Hard Faeces)
Hard Faeces	5-18 g/kg
Water	50-150 ml/kg/day (50-100 probably more accurate)
Urine	20-250 ml/kg/24hrs, usually around 130

Blood collection

- Cephalic/Lateral Saphenous: 25G or smaller. Procedure similar to dog/cat.
- Marginal ear vein/Central ear artery: 25g needle or butterfly catheter, warm ear, clip, and alcohol swab. Allowing blood to drip from needle into syringe often better than syringe as does not collapse vein.
- Consider use of EMLA anaesthetic cream.
- Avoid collecting from central ear artery if possible.
- Jugular Vein: Similar to cats. May be difficult if a large dewlap present.

Urinalysis

Volume	20-350 ml/kg/day, average 130 ml/kg/day
SG	1.003 – 1.036
pH	8.2
Appearance	cloudy due to CaCo3, ammonium magnesium phosphate
Casts	none or rare
Leucocytes	occasional
Erythrocytes	occasional
Albumin	occasionally in young animals

Can carry Bordetella – Potentially pathogenic to Guinea Pigs

FERRET FACT SHEET

Life span	5-12 years (considered geriatric from 5-6 years age)
Weight	600g-2kg; males average 1kg, females 800g
Sexual maturity	4-8 months; females first spring after birth

Induced ovulators – similar to cat

Gestation	40-44 days (average 42)
Litter size	1-18 (average 8)
Birth weight	8-10g
Kits eyes open	21-37 days (average 30-35)
Weaning	6-8 weeks, 300g

Temp	38-40 °C
HR	180-250
RR	33-36
Total blood volume	5-7% bodyweight
Urine	26-28 ml/25hrs; pH 6.5-7.5;

General

Distemper Vaccination	10 & 14 weeks, then annually
Food transit time	>= 180 minutes.
Diet	high protein, high fat, low fibre, and low carbohydrate

Sedation

Ketamine	20-40 mg/kg IM
Diazepam	1-2 mg/kg IM
Domitor (medetomidine)	50ug/kg IM (0.25ml/5kg)

Fluid Rx	75-100ml/k/day maintenance.

Blood Collection

Cephalic/lateral saphenous: 25G or smaller.

Cranial vena cava. Anaesthesia, place at sternal notch, aim towards opposite kidney, mild positive pressure on syringe

Jugular	22-25G needle. Vein relatively more lateral & deep cf cat/dog.
Ventral tail artery	22-25G needle, 1-10ml syringe. Warm tail; dorsal recumbency. Insert 2-3cm from tail base until hit vertebrae. Apply suction whilst slowly withdrawing. Up to 6ml for adult.

SOME USEFUL RESOURCES

Internet

- www.vin.com The Veterinary Information Network:
- www.aemv.org Association of Exotic Mammal Veterinarians
- http:groups.yahoo.com/group/ExoticDVM
- http:groups.yahoo.com/group/UnusualExoticPets (AVA special interest group)
- www.davidvella.com.au

Books

- Meredith A & Redrobe S. (2002). *BSAVA Manual of Exotic Pets 4th Edition*. ISBN 9-780905-214474 British Small Animal veterinary Association, UK
- Quesenberry KE & Carpenter JW (2004). *Ferrets, Rabbits, and Rodents Clinical Medicine and Surgery*. Second edition. WB Saunders. ISBN 10-7216-9377-6.
- O/Malley B. (2005). *Clinical Anatomy and Physiology of Exotic Species. Structure and Function of mammals, birds, reptile and amphibians. Elsevier Saunders.*
- Capello V, (2005). *Rabbit and Rodent Dentistry Handbook*. Zoological Education Network.
- Carpenter JW (2004). *Exotic Animal Formulary* 3rd Edition. WB Saunders. ISBN 978-0-7216-0180-9
- Silverman S & Tell LA (2005). *Radiology of Rodents, Rabbits and Ferrets. An Atlas of normal anatomy and positioning*. Elsevier Saunders.

Journals/periodicals

- Exotic DVM magazine. Published by the Zoological Education Network, PO Box 541749, Lake Worth, Florida 33454-1749, USA. www.exoticdvm.com.
- Journal of Exotic Pet Medicine. www.exoticpetmedicine.com Elsevier Saunders. Official journal of Association of Exotic Mammal Veterinarians.
- Veterinary Clinics of North America. Exotic Animal Practice. Elsevier Saunders.

NOTES:

NOTES:

Chapter 4

Diagnostics: Avian Pathology Sample Collection Techniques

Dr Michael Cannon

BACTERIOLOGY SWABS

Swabs should be moistened with sterile saline prior to use, as drying out will destroy many organisms and a moistened swab is less likely to abrade the sensitive tissues.

Once collected, swabs should be inoculated onto agar gel within one hour or placed into transport medium if being sent to an external laboratory.

To allow collection from small sites such as the rostral choana, calcium alginate swabs designed for the human penile urethra or paediatric trachea are useful.

Storage under refrigeration will also extend the period of microbe survival if it is not to be plated out within one hour.

Do you wish to do these in-house or will you send them to an external laboratory?

I prefer to do Gram stain or other cytology in-house and send swabs for culture and sensitivity to an external lab as their quality control is more stringent and so the results are more reliable.

You can perform Culture and Sensitivity tests in-house, some useful information can be found in the Microbiology section later in this module.

SALINE SMEARS

In the absence of the ability to perform cultures and other expensive tests it is often useful to examine a direct saline smear of exudate, faeces or crop/GIT contents. Protozoa, bacteria and yeasts may be seen if present in large numbers. Their absence in a direct smear does not rule them out.

Samples should be fresh. Dilute the sample with a drop of 0.9% saline (preferably warm) and after gently mixing to a homogenous consistency, place a coverslip on top. Examine under both high dry and low power with the condenser lowered as far as possible.

Hint 1: to easily access warm saline – place a syringe with 1 ml saline in the microwave for a few seconds and the sample will be ideal – please do not forget to remove the needle from the syringe tip or the results will be more than you expect – guaranteed to have all the staff laughing for weeks.

Hint 2: Avoid using tap water as a diluent as it often contains chlorine, which eliminates some protozoa or other motile bacteria you may be searching for.

CROP WASH

Collecting a sample from the crop and proximal oesophagus is a useful technique for diagnosing such problems as Trichomoniasis.

Use warm saline or Hartmann's Solution (not tap water) as this is physiologically balanced.

For birds with a strong bite (raptors, psittacines) use a stainless steel 14-18 GA gavage needle. For other birds a soft plastic or rubber tube may be used. These are attached to a syringe containing the appropriate amount of warm saline.

For a right-handed person the technique is as follows. The bird is held in the left hand so that the head is restrained and the neck is dorsoflexed and fully extended. Enter the mouth on the bird's left side and place the gavage needle so that it rolls over the dorsum of the tongue. Gently slide the tip of the gavage needle towards the bird's right side of the oropharynx and aim towards the angle of the mandible on that side. Minimal pressure is required. The glottis is centrally located at the base of the tongue. If the needle is passed laterally it should avoid the glottis and trachea. If the trachea is entered, then bird will cease vocalising and the cartilaginous rings will be felt at the tip of the needle. Gently direct the needle down the oesophagus - it often is palpable with your thumb - until it arrives at the thoracic inlet. Place the saline into the crop and then aspirate several times. Maintain a gentle negative pressure as the needle is withdrawn to gather more sample from the oesophagus and oropharynx.

Express a small amount of the sample onto a clean warmed microscope slide and place a coverslip in position. Scan at low and high power with the condenser lowered to increase refractive index, providing maximum contrast.

Recommended Volume Administered into the Crop

Species	**ml**
Finch	0.2
Canary	0.2
Budgerigar	0.5
Cockatiel	1.0
Small Parrot	2.0
Medium Parrot	5.0
Large Parrot	10.0

Hint 1: *The secret to success here is the position in which you restrain the bird. The position of the head and neck is the same as if you are passing an endotracheal tube; you need to dorsoflex the head to allow a straight path for the crop tube to pass down. Press down on the shoulders as you extend the neck to align the pharynx and oesophagus. This makes the task much easier.*

Hint 2: *Be aware of the maximum volume to deliver into the crop. Deliver the fluid at a medium to slow pace. If you deliver an excessive amount of fluid or deliver it too quickly, the bird will regurgitate and begin to make spluttering noises. In a healthy bird immediately place it into a cage or confined area and allow it to clear its pharynx. In a moribund bird, immediately invert it, so its head is facing the floor, and allow the excess fluid to fall from the pharynx and mouth.*

BLOOD COLLECTION

The commonly used methods, for routine blood collection, are:

1. Clip a toenail. This is a simple and effective method. If a sharp pair of nail clippers (the pair you normally use for dogs and cats is fine) is used the birds don't seem to experience much discomfort. Be sure to clean the nail with an alcohol swab, to remove any faecal or urate contamination, ***before*** collecting the sample - particularly if you wish to measure uric acid blood levels. Hold the leg extended and relax the toes or you will not be able to sustain a good blood flow. The blood can be collected directly into a microhaematocrit tube from the tip of the toenail.

2. Use a needle to prick the skin directly over the medial metatarsal vein. A small drop of blood will form and this can be collected into a microhaematocrit tube.

3. Insert a 26ga to 30ga needle into the either one of the jugular veins or the Cutaneous Ulnar Veins. Collect into a microhaematocrit tube directly from the hub of the needle or draw blood into a tuberculin syringe.

Blood Volume

As a general guideline, a safe volume of blood to collect from an avian patient is aim for less than 1% of a bird's body weight. The following table provides some examples of volumes you may collect, using this guideline.

TABLE 1: Maximum Blood Volume to collect

Species	Average Body Weight (gm)	Volume (ml)
Finch	15-20	0.15-0.2
Budgerigar	50-70	0.5-0.7
Peachface Lovebird	50-60	0.5-0.6
Princess Parrot	100	1.0
Domestic Pigeon	300-450	3.0-4.5
Galah	400	4.0
Cockatoo	600	6.0

In most cases 0.2-0.5ml is sufficient to do the common tests you will need. The table above demonstrates that this is possible in even a bird as small as a Budgerigar.

In anaemic or ill patients you should always aim to collect the minimum volume possible. Faced with this situation, with some thought and a knowledge of volume of blood required for each test you wish to run, the minimum volume required can be determined and collected accordingly.

Blood Collection Equipment

For most avian species the appropriate equipment for collecting a blood specimen is a 25-30 gauge needle attached to a tuberculin syringe. In some small species it may be more appropriate to fill a microtainer or capillary tube directly from the hub of the needle.

When collecting using a syringe, take care not to draw back too vigorously or it will result in the vein collapsing. As well haemolysis will result if the sample is collected too quickly through a fine gauge needle.

Suitable blood containers for avian blood samples are standard microhaematocrit tubes (usually 70ul), with or without anticoagulant. A useful collection tube is the small volume Microtainers from Becton-Dickinson. Tubes containing a plasma/serum separator can be useful as they allow a maximum volume of serum to be harvested.

Anticoagulants

The two most commonly used anticoagulants, EDTA and heparin, are acknowledged to affect stain quality and cell morphology as well as increasing haemolysis and changing biochemical values. To overcome this it is recommended that blood smears are best made at the time of collection, prior to the addition of anticoagulant.

EDTA is the best for preserving cell morphology and the staining quality of leukocytes. Avoid excess amounts of EDTA as it causes shrinkage, degeneration and lysis of erythrocytes and interferes with leukocyte staining. It is not recommended for samples for biochemistry as it interferes with values for electrolytes, Calcium, LDH, TPP and Lead.

In species listed below, it should be avoided for haematology as it causes haemolysis and increased viscosity:

Corvidae (Magpie, Raven, Crow)

Megapodidae (Ostrich, Curassow, Brush Turkey, Mallee Fowl)

Kookaburras

Crowned Cranes

Some Penguins

Heparin is indicated for clinical chemistry samples. Blood collected into plain tubes does not clot for up to an hour and this may cause spurious results. Lithium Heparin is the preferred form as the Sodium and Potassium forms of heparin will interfere with electrolyte values.

Harvesting Plasma

The current recommendation is that the blood sample be collected into lithium heparin and centrifuged as soon as possible. The plasma should be harvested and placed into a plain tube. This gives more accurate clinical chemistry results, as whole blood will develop artefacts such as increases in Potassium, LDH and TPP as well as decreases in Glucose and changes to Calcium and Phosphorus levels.

Collection Sites

(A) Jugular Vein

The right jugular vein is usually larger and easily accessible in finches and parrots. A spray of alcohol onto the skin and feathers above the jugular area will aid visualisation of the vein and avoids the need to pluck feathers. In these species the sample can be collected without an assistant. To avoid haematoma formation, you should apply pressure over the collection site for 30-60 seconds. This is not a suitable collection site in species which lack a featherless tract in the cervical region e.g. pigeons, penguins and most waterfowl. It should not be used as a site for blood collection in Ratites, as it has been associated with severe lacerations of the vein, if the bird suddenly moves its neck, and blood loss sufficient to cause death.

(B) Medial Metatarsal Vein

This is a useful vein in larger species e.g. pigeons, waterfowl and raptors. The most useful position to collect from using this vein is the medial aspect of the hock joint. An assistant is recommended to help restrain the patient.

(C) Cutaneous Ulnar Vein

This vein is most easily located at the ventral aspect of the elbow joint. Spray the area with alcohol to aid visualisation and avoid the need to pluck feathers. An assistant is recommended to restrain the bird. This location is prone to extensive haematoma formation following venipuncture. Care should be taken to apply pressure for up to 3 minutes post-collection and perform a minimal trauma venipuncture when using this site. This is the recommended site for collection from Ratites. For use in small species such as finches, it is recommended to simply prick the vein with a fine gauge needle and collect the sample directly into a microhaematocrit tube.

(D) Toenail Clip

To avoid contamination with faeces and urates, the claw to be used for blood collection, should be thoroughly cleaned with alcohol and allowed to dry, prior to collection. A sharp pair of nail clippers is used to remove the distal 1/3 of the largest claw/toenail. The clippers should be applied in an anterior-posterior position (NOT at the lateral aspect) as this helps to dilate the blood vessel. Restrain the leg by holding the thigh and not the foot, and avoid pinching the toe or this will constrict blood flow. Do not 'milk' the toe to collect the sample as this will change the cellular content and may affect some chemistry levels (e.g. LDH). To avoid contamination from tissue fluid, do not collect the first drop of blood. The sample can be collected into either a microhaematocrit tube or into a microtainer. Haemostasis of the claw, after collection of your sample, is achieved by direct application of Ferric Chloride, Ferric Sulphate, Silver Nitrate or Tissue Glue (Vetbond). Place the bird under close observation for up to 30 minutes to ensure bleeding does not resume.

DIAGNOSTICS:

Haematology

Biochemistry Evaluation

Examination of the Droppings

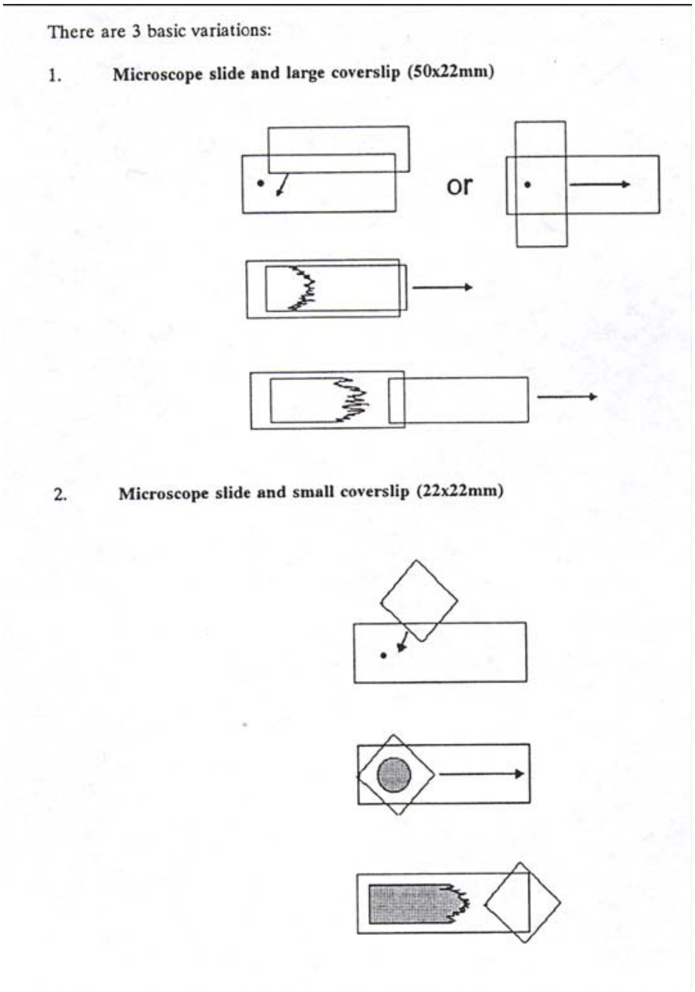
Faeces Evaluation

Urinalysis

Haematology

Blood Smears

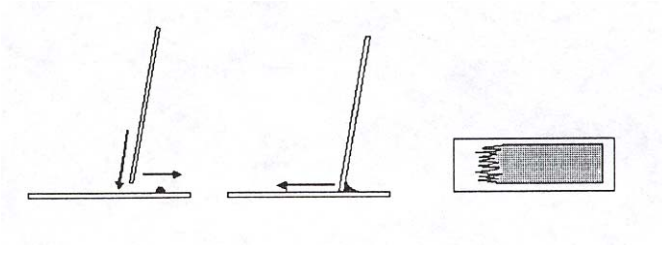
The best results are achieved if fresh blood is used, rather than making smears from blood containing anticoagulant. However, if there is no alternative, samples containing EDTA or heparin will suffice. Of all the techniques for making a smear, the most satisfactory for achieving a good monolayer is the technique using two coverslips (22 x22 mm) or a glass slide and a large coverslip (22 x 44mm). This technique has a greatly reduced white cell margination and numbers of smudge cells compared to other methods. The major disadvantage is the fragility of the coverslips for handling during staining or transport.



There are 3 basic variations:

1. **Microscope slide and large coverslip (50x22mm)**

2. **Microscope slide and small coverslip (22x22mm)**



Note: the remaining notes on haematology and biochemistry are in the section on practical classes.

Cytology

The most common application of cytology in avian diagnostics is its use as an in-house application for the following:

1. Skin Scraping

2. Feather Structure

3. Aspirates from (e.g. fine needle aspirates)
    - external masses
    - enlarged organs such as the liver
    - swollen joints
    - crop wash

4. Fluids from
    - crop
    - proventriculus
    - Infraorbital sinus
    - trachea
    - coelomic cavity (abdominal aspirate/paracentesis)

5. Impression or exfoliative cytology from
    - open lesions
    - cornea
    - cloaca
    - oral cavity
    - material gathered at post mortem examination

6. Faecal material

7. Urine

8. Blood tissue

9. Bone marrow

10. Gram Stain - from any location

In most cases a suitable stain is Wright's stain.

Cytology is often an overlooked area for bird medicine and diagnostics.

Evaluation of Droppings

The specimen a bird passes from its cloaca is a combination of faeces, urates and urine. Each component should be assessed separately to determine if it falls within the normal range or if it indicates disease.

Interpretation of Droppings

The cloaca acts as a common receptacle for the contents of the bird's digestive, urinary and reproductive systems. These are expelled through the 'vent' and are correctly called 'droppings'. A normal dropping should contain excretory products from either the intestine or urinary tract or more commonly both systems.

A bird's droppings will often give valuable information regarding the state of health. Therefore, it is a good idea to pay close attention to them. Look at the droppings on the floor of the cage or any samples brought in by the owner - is there an increased or decreased number? Assess the urinary and faecal components. When examining the floor of a cage containing a bird brought in to the practice, expect a ***temporary polyuria*** due to the stress and excitement of transport.

In seed-eating birds, the faecal (stool) portion of the dropping should be a shade of green or brown (colour will be influenced by both pigments in the diet and bile pigments from the liver) and should be formed into a coil. Size and diameter of the faeces will vary with the length and diameter of the intestine.

Dark coloured faeces may be melena (check the bird has not been eating dark pigmented food such as blackberries).

Bright green faeces may be a sign of hepatic disease or haemolysis and are common with malnutrition, toxins, *Chlamydia*, bacterial septicaemia and some viral diseases.

Pale coloured faeces may be seen with malabsorption / maldigestion syndromes.

The ***texture*** of the faeces may aid diagnosis. Normal faeces is a tight cylinder that has a smooth pasty consistency. A granular stool or presence of undigested food may be associated with malnutrition/maldigestion or decreased passage time due to parasites or inflammation of the pancreas, proventriculus, gizzard or intestines.

Along with the faecal component will be a variable amount of uric acid or ***urate*** (solid component) and ***urine*** (liquid component). The urates will usually be in a blob or mixed in stringy fashion with the faeces and should be absolutely white, or perhaps beige in colour. The urine should be clear and will wet the papers on the cage bottom for a variable distance beyond the perimeter of the dropping. The ability to determine the amount of urine will vary with the type of substrate on the bottom of the cage. Newspapers or absorbent paper towel is the recommended material to use on the floor of a cage, as it will give you the ability to regularly monitor the droppings. It is impossible to evaluate each individual dropping as a discrete entity when food, kitty litter or other materials cover the cage bottom. The amount of urine excreted is usually quite small.

Green discolouration of the urates or urine staining may be found with hepatic disease or haemolysis from similar causes stated above for the faeces.

A bird is considered to have diarrhoea when the faecal portion of the dropping is not well formed. ***Diarrhoea*** is actually not a very common clinical entity. A dropping containing a normally formed faecal portion but possessing a large amount of urine around it represents a watery dropping and is actually polyuria not diarrhoea!

It is important to examine the droppings closely and make distinctions between the components. In all cases of diarrhoea the droppings will appear loose, but not all loose or watery droppings constitute diarrhoea. This is an extremely important distinction to make.

Polyuric droppings may or may not indicate disease. Diabetes and renal disease are the most commonly encountered pathologic causes of polyuria. However polyuria can result from psychogenic (excitement, stress), physiological (increased water consumption on the part of the bird e.g. feeding young) or dietary (increased amounts of fruits and greens/vegetables) causes. Use information gleaned during the history to help differentiate these.

It is important to note that ***qualitative*** (colour, consistency, etc.) and ***quantitative*** (amount of each component) aspects of the droppings of normal caged birds frequently change, depending on the foods consumed, the amount of water consumed, the amount of stress experienced, mood changes, etc. Abnormal droppings will typically remain abnormal in appearance during the entire course of a bird's illness.

Faeces Evaluation

Faeces should be evaluated for:

A. Colour

B. Consistency

C. Volume

D. Microscopic examination

A. Colour

Colour can be affected by:

- Diet
- Hydration
- Disease
- Species

Diet

Pigments in the diet may change the faecal colour. Large amounts of greens send the colour green, while Tannins sends the faeces reddish-brown.

Hydration

A dehydrated bird will resorb more fluid in its GIT, resulting in a darker dropping, from concentration of pigments.

Disease

Pale, light-coloured faeces are associated with malabsorption syndromes or pancreatic disease, often referred to as 'Popcorn Poo'.

Dark black/brown faeces are a sign of bleeding high in the GIT.

Vivid, lime-green (chartreuse) is associated with acute, severe liver disease.

Species

NORMAL COLOURS	
Grey, green or dark brown	Seed eaters
Dark brown/black	Carnivorous
Light brown or grey	Nectarivorous
Dark green or brown	Ratites

Colour changes

1. Green

- Inadequate food intake
  - anorexia
  - disease
  - inadequate food sites in overcrowded aviary
- Increased passage through intestine
  - Infection
    - * Bacteria e.g. *Salmonella*, *E. coli*
    - * Yeasts e.g. *Candida*
    - * Megabacteria
    - * Viruses e.g. Herpesvirus
    - * Protozoa e.g. Coccidia (*Eimeria*, *Isospora*)
      Hexamita
    - * *Chlamydia*
    - * Intestinal parasites (ascarids, capillaria)
- Dietary components
  - Silverbeet or other greens
  - legumes (peas)

2. Pale

- Pancreatic Disease
  - maldigestion
  - 'popcorn poo' (you will recognise it when you see it)
- Enteritis
  - malabsorption
- Liver Disease
  - bacteria
  - *Chlamydia*
  - trichomoniasis

3. Red-Brown

- Dietary pigments e.g grain with a high tannin content (sorghum)

B. Consistency of Faeces

This will vary with the fluid content of the faeces.

1. Decreased Fluid Content

- Dehydration
- Desert dwelling species

  e.g. Budgerigars eat a dry diet and consume small amounts of water

- Ill birds consume less water

2. Increased Fluid Content

- Diet containing green vegetables, fruit or nectar
- Excessive salt in diet
- Diarrhoea (don't confuse with polyuria)
  - infection
  - parasites
- Response to progestagens - soft, moist faeces

3. Undigested Food present

- gizzard disease
- lack of grit
- enteritis
    - infection
    - parasites

C. Volume of faeces

1. Decreased volume

- decreased food intake
- inappropriate food provided
- anorexia
- starvation
- GIT obstruction

2. Increased volume

- Normal
    - egg-laying hens
- Polyphagia
- Diabetes mellitus
- Young birds with new food items
- Ratites following relocation
- Vitamin E/Selenium deficiency
- Intestinal malabsorption
- Enteritis
- Maldigestion
    - pancreatic disease
    - liver disease

D. Microscopic Examination of Faeces

It is recommended that both faecal flotation and wet smear be used to avoid missing some pathogens. The tests commonly performed are:

1. Flotation and wet mount
2. Saline Smear/Wet Mount
3. Special Stains (Trichrome, Gram)

Urine/Urates Evaluation

Assessment of urine/urates consists of evaluation of:

A. Urinalysis

B. Colour

C. Volume

D. Consistency

E. Sediment analysis

Urinalysis

Normal Psittacine Urinalysis Findings	
Specific gravity	1.005 - 1.02
pH	6-8
Glucose	Negative to trace
Blood	Negative to 1+
Protein	Negative to trace
Ketones	Negative
Bilirubin	Negative
Casts	NIL
Colour	Clear

Sources of Colour Changes to Urine/Urates

1. Drugs

- bright yellow to orange can result from administration of B Vitamins

2. Diet

- dietary pigments such as carotenes will appear

3. Anorexia

- dull yellow to yellow-green colour

4. Liver Disease

- green from biliverdinuria

5. Haematuria (tomato-soup like, creamy red-brown)

- brown or port-wine colour suggests renal disease or
- haemolytic disease or toxins such as heavy metals

6. Frank blood

- may be associated with trauma, renal disease or heavy metal toxicosis

Volume of Urates/Urine

Normal cage birds only produce a small amount of urine. Polyurates are associated with increased catabolism and anorexia.

Meat and fish eating birds such as raptors and sea birds normally produce a large amount of urates to handle the large amount of protein in their diet.

An increase in volume can be associated with:

1. Dietary Polyuria

Increased fluid intake with green, leafy vegetables, fruit or nectar. Increased salt content of diet promoting polydipsia. Increased fluid content of hand rearing diet or fluid diet for an ill bird.

2. Medications

Corticosteroids, progestogens and diuretics will all cause a secondary polyuria.

3. Reproductive Status

Hens due to lay an egg will produce larger volumes of urates.

4. Neoplasia

Renal tumours often cause polyuria.

5. Toxins

Aflatoxins, heavy metals, plant toxins and Aminoglycosides often cause polyuria.

6. Diabetes Mellitus

Typical Polydipsia/Polyuria signs as well as increased glucose and hyperglycaemia. May be secondary to peritonitis.

7. Diabetes Insipidus

This is rarely seen, and then usually in budgerigars and cockatiels

8. Psychogenic Polydipsia

Normal in all aspects other than over-consumption of water. Most common in cockatoos, cockatiels or recently weaned birds

9. Stress

A frightened bird will produce a very fluid dropping. This is the type of dropping passed during the trip to the veterinary hospital and in the consulting room. Do not interpret this as polyuria.

Chronic stress may raise the plasma cortisol level to increase urine volume.

Consistency of Urates

Viscosity increases with dehydration.

Sediment Analysis (carry out normal centrifugation)

1. Epithelial cells if present may suggest disease

   Crystals - urate crystals are normal

2. RBC & WBC - difficult to interpret as source may be GIT, reproductive tract, urinary tract or cloaca.

3. Bacteria, yeasts and fungi are usually from the GIT.

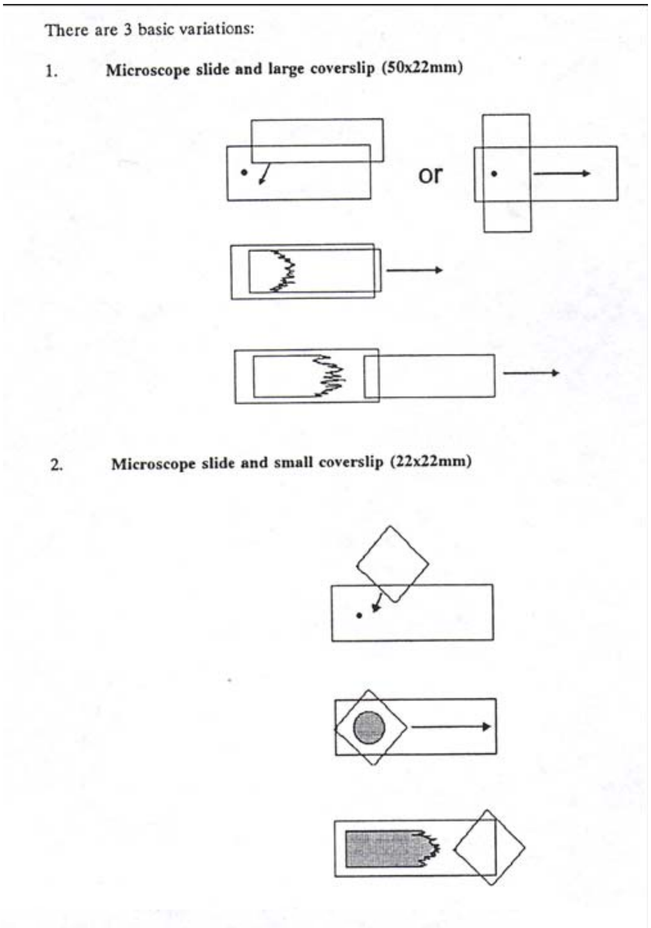
4. Sperm may be seen in sexually active males

6. Casts - presence or absence is a significant finding.
   - presence is commonly associated with renal disease

AVIAN HAEMATOLOGY - PRACTICAL NOTES

Blood Smears

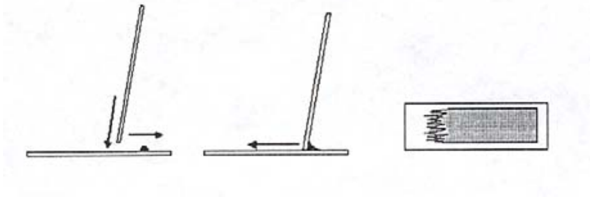
The best results are achieved if fresh blood is used, rather than making smears from blood containing anticoagulant. However, if there is no alternative, samples containing EDTA or heparin will suffice. Of all the techniques for making a smear, the most satisfactory for achieving a good monolayer is the technique using two coverslips (22 x22 mm) or a glass slide and a large coverslip (22 x 44mm). This technique has a greatly reduced white cell margination and numbers of smudge cells compared to other methods. The major disadvantage is the fragility of the coverslips for handling during staining or transport.



There are 3 basic variations:

1. **Microscope slide and large coverslip (50x22mm)**

2. **Microscope slide and small coverslip (22x22mm)**



Smear Evaluation

Look at each cell line thoroughly before moving to the next one. A recommended order is RBC, TBC (Thrombocyte), WBC (each cell type). Scan the slide looking for similar cell types to help differentiate cells that may be similar e.g. differentiate lymphocytes from monocytes, and then heterophils from eosinophils. This helps to compensate for differences between species and staining quality of different slides.

Haematology Stains

The two stains most commonly used in practice are Diff Quick and Wright's Stain. The Diff Quick is rapid but may cause problems differentiating some of the granulocytes. Wright's stains take longer to perform but give good detail of granulocytes.

1. Diff Quick

The reagents must be correctly stored to protect them from evaporation or moisture contamination. If the reagents are aged they will give poor staining quality.

Step 1: Place slide in fixer solution for at least 30 seconds.

Step 2: Use 10-20 x 1 second dips in Eosin Solution. Drain off excess. Extra dips will increase eosinophilia in the cytoplasm and granules.

Step 3: Use 10-20 x 1 second dips in Methylene Blue Solution. Drain off excess. Extra dips will increase basophilia in the nucleus and granules.

Step 4: Rinse slide under a stream of water to remove sediment. Tap water is usually acceptable for this. Allow slide to dry or use a hair dryer.

Step 5: Examine under microscope. If there is insufficient staining, the slide may be restained by repeating the process above. E.g. to increase basophilia apply more dips into Solution 3 - Methylene Blue.

2. Wright's Stain

This is a commercially available stain that often is accompanied by complex instructions. The following set are those recommended by Hume (1994) in his comparative studies of staining characteristic of avian blood.

This is a two step stain. The first step allows the methanol in the stain to fix the cells. The second step is when the staining occurs.

Longer fixation or staining times will increase stain depth and intensity. However as the stain reagents age they will need longer times to achieve good quality.

Step 1: Place air dried, unfixed smear on staining rack.

Step 2: Fixation. Flood smear with stock solution for 2-4 minutes.

Step 3: Staining. Add an equal volume of distilled or buffered (pH 6.4-6.8) water. Gently blow on slide to facilitate mixing. A greenish, metallic sheen should appear. Leave for 3-6 minutes.

Step 4: Rinse quickly with distilled or buffered water. Shake off excess.

Step 5: Clean back of slide with alcohol moistened swab. Allow to air dry or use a blow dryer.

Evaluation of Erythrocytes

Avian erythrocytes have a relatively short life span of 20-45 days and are relatively large compared to mammalian cells. The most obvious difference is the presence of a nucleus. The same tests as used in mammals can be applied with certain modifications. In a clinical situation Total Red Cell Counts are not practical. The two main techniques used are the Packed Cell Volume and the Avian Polychromatophilic Index. If anaemia is present a reticulocyte estimate can be done.

Packed Cell Volume (PCV)

This is a quick and simple method that is available in most small animal clinics. The specimen is collected into a heparinised microhaematocrit tube. Centrifuge at 12,000g for 5 minutes at least. The normal range for most birds is 35-55%.

A PCV less than 35% suggests anaemia.

A PCV greater than 55% suggests dehydration, particularly if TPP is also increased. Dehydration may be masked by anaemia and hypoproteinaemia. Use the history to help determine if this may be the case.

Other information that can be gained from the microhaematocrit tube:

- Total Plasma Protein estimation using a refractometer is useful. The normal range for most species is 2.5-5.0 mg/dL.
- Lipaemia may be due to sample collection post-prandial (i.e. not a fasting blood sample) or it may be an indication of activity in the ovary with egg laying being imminent. High fat seeds in the diet (e.g. sunflower, safflower and peanuts) may also show as lipaemia.
- Examination of the buffy coat can give a rough estimate of total White Cell Count. Less than 1% is considered normal.
- Light yellow coloration of the plasma can be normal due to carotenoid pigments in the diet. Darker shades may indicate icterus.
- A pinkish tinge to the plasma may be an indication of haemolysis. This will cause a reduced PCV as well. The cause of haemolysis is usually poor collection technique or prolonged/poor storage.
- Plasma from a collection of microhaematocrit tubes can be harvested for clinical chemistry evaluation.

Avian Polychromatophilic Index

The degree of immature erythrocytes can be a useful parameter to assess the bird’s erythropoietic response, particularly where anaemia is present. It can be used as a guide to separating anaemia into either regenerative or non-regenerative. It is also a rough guide to the bird's ability to cope with and respond to disease. An ill bird with anaemia and very little polychromasia has a guarded prognosis.

Compared to mature cells, immature erythrocytes have the following characteristics:

- more rounded shape
- more basophilic cytoplasm
- less densely staining nucleus

Normal birds have 1-5% polychromasia i.e. Grade of 1.

Table 2: Polychromatophilic Index

Estimated Grade	% Polychromasia	Comment
1	1-5	almost no polychromasia
2	5-10	a few polychromatic cells
3	10-20	moderate numbers of polychromatic cells
4	20-50	significant numbers of polychromatic cells
5	> 50	highly polychromatic and significant poikilocytosis

Reticulocyte Estimation

Step 1: Mix whole blood with an equal volume of 1% New Methylene Blue stain.

Step 2: Allow to stand for 10 minutes.

Step 3: Use this specimen to perform a normal blood smear.

Step 4: Examine the smear under oil immersion.

Step 5: Count 500-1000 erythrocytes and record the % of reticulocytes.

Reticulocytes are identified as cells with either:

- 4 clumps or strands of blue reticulum within the cytoplasm
- a complete ring of blue reticulum around the nucleus

The normal value for reticulocytes is <10%.

The equivalent of the mammalian platelet this is the cell involved in coagulation. It is a nucleated cell. It can be difficult to calculate a Total Thrombocyte count as these cells in a normal bird tend to form clumps at the feathered edge of a smear. The following means can be used to gain an estimate:

- expect 1 thrombocyte per 75 erythrocytes
- expect 1-2 thrombocytes per oil immersion field (at 1000x magnification)

As well the following formula may be used:

$$\textbf{Estimated TBC/uL} = 3{,}500{,}000 \times \frac{\textbf{Average No TBC in 5 OIF}}{1000}$$

(TBC = Thrombocyte, OIF = Oil Immersion Field)

Packed Cell Volume Correction

If the PCV is outside the normal range a correction should be made:

$$\textbf{Corrected TBC/uL} = \textbf{Estimated TBC} \times \frac{\textbf{Observed PCV}}{\textbf{Average Normal PCV (47.7\%)}}$$

Leukocyte Evaluation

Total White Cell Count (WCC)

The automated cell counters used in mammalian blood counts are unsuitable for avian blood because of the nucleated erythrocytes and thrombocytes. For practical purposes an estimated WCC is performed rather than the direct count using a haemocytometer. There is considerable debate in the literature as to whether this is a reliable method of recording the WCC.

Step 1: Scan the blood smear on low power and find a well stained monolayer

Step 2: Count all the WBC in 10 fields using the x40 objective (high, dry lens)

Step 3: Calculate the average (divide by 10)

Step 4: multiply by 2 - this is the estimated WBC x 10^9/L

Step 5: Express this as a range depending on the final calculation

WBC x 10^9/L	**Range Spread**
up to 25	2
25-40	4
40-65	5
65-140	10
140+	20

e.g. an estimated total WCC of 28 x 10^9/L would be have a range of 4 and be recorded as 26-30 x 10^9/L

An alternative technique for WCC estimation is to use the oil immersion objective lens (x 100) and count the number of leukocytes in 5 oil immersion fields. This is your count x 10^9/L. This is less reliable.

Packed Cell Volume Correction

If the PCV is not within the normal range, the estimated WCC can be corrected with the following formula:

$$\textbf{Corrected WCC} = \textbf{Total WCC} \times \frac{\textbf{Observed PCV}}{\textbf{Normal PCV (47.7\%)}}$$

Differential Leukocyte Count

Step 1: Count 100 Cells using battlement technique. Find a straight edge or a good evenly distributed monolayer. Count two fields horizontally, then two fields vertically, then two fields horizontally etc. until 100 cells are counted. More than 100 cells can be counted but it is not statistically more accurate until 400 cells are counted.

Step 2: Identify each type of leukocyte

- Heterophil
- Eosinophil
- Basophil
- Monocyte
- Lymphocyte

Step 3: Record each cell type as a % and then calculate an absolute value based on WCC

Step 4: To aid differentiation, examine each cell for:

- size and shape
- mature cell vs immature cell
- colour of cytoplasm and granules
- presence of parasites or vacuoles
- nucleus - shape, staining and chromatin structure

Table 3 Differentiating Erythrocytes

Cell Stage	Shape	Cytoplasm	Nucleus	Comment
Mature Erythrocyte	Oval	Orange-pink no inclusions	Centrally placed	condensed dark staining chromatin
Immature Erythrocyte	More rounded	A more bluish tinge		Less condensed chromatin
Erythroblast	Round	Dark blue	Uniform, dark-staining chromatin	High Nucleus:Cytoplasm ratio

Table 4 Differentiating Leucocytes

Cell	Shape	Cytoplasm	Nucleus	Comment
Mature Heterophil*	Round	Colourless, maybe pink if degranulation occurs	Lobular if 2 lobes or more	Granules are rod/spindle shaped
Immature Heterophil	Larger than mature	As in mature but fewer granules that are different from mature granules often spherical	Unlobulated, round or bean shape	If present in significant numbers, prognosis is poor
Toxic Heterophil	Smaller than the Mature H.	Vacuolation and degranulation present	hypersegmented or degenerated	Granules become basophilic
Eosinophil	Round with a wide range in size even on the same smear	Pale blue Granules stain dull red or may be absent	Lobed and often round shape Darker staining than heterophil	Expect 2-3% increase with parasite burden or in response to allergens
Basophil	Round, smaller than Heterophil	Clear with round, uniform intense basophilic granules	Single lobed Pale staining	Have a similar role to that of Mast Cell in mammals.
Lymphocyte**	Round, Variable size and number	Basophilic Reactive cells have blebbing	Usually central High N:C ratio Densely clumped Chromatin	Most frequent leucocyte in lymphocytic species (e.g. Amazon Parrots)
Monocyte	Round or slightly irregular. Larger than Heterophil	Usually more cytoplasm than Lymphocyte. Grey-blue with ground glass appearance	Round to elongated Often kidney shaped with indentation. Finer reticular chromatin than Lymphocyte. Often Eccentric	Seen as a response to chronic disease e.g. TB or *Chlamydia*
Thrombocyte	Oval, smaller than Erythrocyte	Colourless to pale blue	More rounded than Erythrocyte. Deeper more uniform staining of chromatin	Frequently form clumps

* The Heterophil is the avian equivalent of the mammalian Neutrophil. It lacks the protease lysozyme, found in Neutrophils, and this explains why purulent exudate in birds does not liquefy but forms an exudate with the consistency of cottage cheese.

** Small & medium lymphocytes are the mature cells.

Large lymphocytes are regarded as immature cells.

Small lymphocytes may be confused with thrombocytes.

Cell Differentiation Hints

The following cells may be difficult to differentiate. Use these comparative tables as a guide.

	EOSINOPHIL	**HETEROPHIL**
Size		heterophils larger on same smear
Cytoplasm	pale blue	colourless
Cytoplasmic Granules	usually round	usually rod shape
Nucleus	usually bluer & more distinct	usually more lobulated

	THROMBOCYTES	**LYMPHOCYTES**
Cell Shape	usually oval	usually round but may mould to adjacent cells
Cytoplasm	clear to blue-grey	lightly basophilic
Cytoplasmic Inclusions	small eosinophilic granules or clear vacuoles at poles	Azurophilic granules maybe present throughout cytoplasm are larger than granules in thrombocyte
Nucleus	round & central. Darker denser chromatin	may be eccentric, less dense chromatin

	LYMPHOCYTES	**MONOCYTES**
Cell Size	3 sizes (small, medium, large). Majority are small and medium i.e. smaller than heterophil	larger than heterophil
Cell Shape	round or irregular with irregular cytoplasmic projections or blebs	round, oval or slightly irregular. Often mould around adjacent cells. Occasional peripheral cytoplasmic projections
N:C Ratio	higher except in large lymphocytes, which have more cytoplasm	smaller ratio than in lymphocytes, i.e. have more cytoplasm
Cytoplasm	homogenous, clear to weakly basophilic	grey-blue with ground glass appearance. May have two zones - outer pale staining and inner more densely staining
Cytoplasmic Inclusions	uncommon - Magenta or azurophilic granules if present	often have fine, dust-like azurophilic granules
Nucleus	round, may have very shallow indentations. Dense chromatin clumping in mature cells	Variable shape - round, elongated, kidney, Bilobed delicate reticular chromatin with a few dense clumps

Reference

Hume, A. (1994). *Practical Avian Haematology*, in Annual Conference Proceedings Australian Committee Association of Avian Veterinarians, 1994 Pp. 271.

INTERPRETATION OF HAEMATOLOGICAL CYTOLOGY

1. Erythrocytes

* **Anisocytosis** = variation in red cell size

a slight degree is normal

expect this to be increased in anaemia

* **Microcytosis** = a smaller than normal cell

seen in blood loss anaemia

* **Poikilocytosis** = variation in red cell shape

not prominent in normal birds

expect this to be increased in anaemia

* **Reticulocytosis** = an increase in the reticulocyte count, above normal

polychromasia is usually a sign of increased reticulocyte count.

normal = 0-10% reticulocytes

* **Hypochromasia -** reduced haemoglobin concentration

Expect this with:

blood loss anaemia

lead poisoning

iron deficiency

* **Regenerative anaemia**

Polychromatophilic Index 1-2

reticulocytosis > 10%

anisocytosis > 1+

poikilocytosis +/-

* **Non-responsive anaemia**

polychromatophilic index 1-2

reticulocytes < 10%

2. Thrombocyte Count

Reactive thrombocytes have:

- bleb formation in the cytoplasm
- distorted shape
- grey cytoplasm
- vacuoles may be present

They are associated with:

- serious viral or bacterial infections
- Anaemia
- Chronic disease
- Heavy metal toxicity

Thrombocytopaenia: is associated with:

- DIC
- Septicaemia
- Haemopoietic neoplasia

Thrombocytosis: is associated with:

- severe infections/acute septicaemias
- parasitaemia

3. Leukocytes

Heterophil

Differentiate from eosinophils: see the chart above.

Staining artefact: if the smear is left in fixer (methanol) too long the granules will dissolve and the cell be incorrectly identified

Immature (band) heterophils are associated with infection or blood loss being so prominent that bone marrow depletion has occurred

Toxic heterophils: their presence is suggestive of infection

cytoplasm basophilic, vacuoles present

granules become basophilic

nucleus hypersegmented or degenerated

Lymphocyte

Differentiate from thrombocyte and monocyte: see the chart above

Immature (large) lymphocytes present in large numbers may indicate leukaemia.

Reactive lymphocytes indicate antigenic stimulation.

cytoplasm deeply basophilic

cytoplasmic blebbing

perinuclear clear zone

nuclear chromatin dark staining and densely clumped

BASIC INTERPRETATION OF HAEMATOLOGY

Interpretation is similar to that used in mammals. These tables list likely conditions associated with changes to each parameter.

PCV	
Increased (> 55%)	**Decreased (< 35%)**
Dehydration	Anaemia
Haemoconcentration	Blood loss/haemorrhage
	RBC destruction
	Decreased RBC production
	Blood loss/haemorrhage * Ectoparasites * Endoparasites: coccidia, nematodes * Trauma * GI haemorrhage * Ulcers: Megabacteria, *Candida* spp, heavy metals * Bleeding tumours: GIT, kidney * Coagulopathy: chronic liver disease, rodenticide toxicity
	RBC destruction * Haemoparasites: *Plasmodium, Haemoproteus* * Bacterial infection: *Salmonella,* Spirochaetosis * Heinz Bodies * Toxin from plants: Mustard family
	Decreased RBC production * Nutritional deficiency: iron, folic acid, starvation * Chronic disease: Aspergillosis, liver disease, renal disease * Toxins: lead, aflatoxin, selenium, chloramphenicol * Neoplasia: leukosis

WCC & DIFFERENTIAL (A normal WCC can occur in chronic equilibrated disease. This is suspected if the bird is obviously ill or abnormal/toxic leukocytes or a left shift is present.)	
Increased **(increased WCC = leukocytosis)**	**Decreased** **(decreased WCC = leukopaenia)**
Inflammatory process * Bacteria * Fungi * *Chlamydia*	Overwhelming infection
Tissue trauma	Viral disease esp. PBFD
Stress	Anaemias
Corticosteroids	Bone marrow hypoplasia * Toxins * Neoplasia
Neoplasia	
Blood loss * Bone marrow rebound	

HETEROPHIL	
Increased (heterophilia)	**Decreased (heteropaenia)**
Acute infections	Overwhelming bacterial infection
Inflammatory response e.g. tissue trauma	
Chronic inflammation	
Acute blood loss	
Stress/corticosteroids in heterophilic species	
Vitamin B1 & B2 deficiency	
Band Heterophilia (Left Shift) Severe inflammatory disease * Bacterial septicaemia * Egg yolk peritonitis * Chlamydiosis	

EOSINOPHIL	
Increased (eosinophilia)	**Decreased (eosinopaenia)**
Allergy	Not clinically significant
Parasites * Intestinal: Ascarids, *Capillaria, Giardia,* tapeworm * Cutaneous: Mites e.g. *Cnemidocoptes, Sternostoma* * Haemoparasites: *Plasmodium, Haemoproteus,* Leukocytozoon	

BASOPHIL	
Increased (basophilia)	**Decreased (basopaenia)**
Tissue trauma	Not clinically significant
Chronic disease * Respiratory infection * Respiratory parasites * *Chlamydia* (often subclinical)	

LYMPHOCYTE	
Increased (lymphocytosis)	**Decreased (lymphopaenia)**
Stress/corticosteroids in lymphocytic species	Acute infection
Chronic viral infection	Viral infection
Chronic inflammation	Toxins
Neoplasia * Leukosis	Nutritional deficiency * Vitamin A * Vitamin B1 & B2 * Folic acid
Reactive lymphocytes may be seen in these conditions above esp. with *Chlamydia* and Mycobacteria or with haemoparasites in passerines * Plasmodium * Atoxoplasma	

MONOCYTE	
Increased (monocytosis)	**Decreased (monocytopaenia)**
Chronic inflammation	Not clinically significant
Chronic infection * *Chlamydia* * *Aspergillus*	
Granuloma production * *Mycobacterium* * *Aspergillus*	

TYPICAL DISEASE PICTURES DETECTED IN THE BLOOD COUNT

1. **Typical Chlamydiosos**

leukocytosis, monocytosis, toxic heterophils with a left shift

2. **Atypical Chlamydiosis** (seen in small birds e.g. cockatiel, budgerigar)

slight monocytosis, basophilia

3. **Granuloma Producing Diseases** (*Salmonella*, *Aspergillus*, *Mycobacteria*)

persistent monocytosis

4. **Neoplasia** (leukaemias)

a) Lymphoid Leukosis

Marked lymphocytosis with many lymphocytes having scalloped cytoplasmic borders. Many lymphocytes are immature or they have deep nuclear indentations or partial lobulation of nucleus. Often also a normocytic, normochromic, non-regenerative anaemia.

b) Erythroblastosis

Large numbers of erythroblasts: large round nucleus, fine chromatin, 1-2 well staining nucleoli, relatively large amount of basophilic cytoplasm. Often a perinuclear halo is present.

c) Myeloblastosis

Large numbers of myeloblasts: large cells with slightly basophilic, clear cytoplasm and a large nucleus with 1-2 nucleoli that do not take up stain well. Often promyelocytes and myelocytes are present. Up to 75% of cells will be abnormal on the smear.

BIOCHEMISTRY

Measurements of the clinical chemistries are often required because signs of disease in birds are often subtle and unreliable.

The following tables are an attempt to correlate changes in the biochemistry profile with possible disease entities. It is only a guide.

The clinical chemistry parameters can be divided into three groupings:

(a) Enzymes - indicators of cellular damage

(b) Metabolites - indicators or products of metabolic pathways

(c) Electrolytes - occurring as free ions in plasma, involved in homeostasis of blood pH.

(a) Enzymes

PARAMETER	INCREASED	DECREASED
Alkaline Phosphatase	•musculoskeletal disease •bone diseases •bile duct disease •corticosteroids •higher in juveniles	•zinc deficiency
LDH	•haemolysis •hepatic necrosis •muscle damage	
AST (formerly SGOT)	•hepatic disease •cardiac disease •skeletal muscle disease •selenium/Vitamin E deficiency	•not significant
ALT (formerly SGPT)	•non-specific cell damage	
Gamma GT	•possible biliary disease •hepatocellular damage •some renal diseases	•not significant
GLDH	•hepatocellular necrosis	•not significant
CPK	•reaction to restraint •skeletal muscle disease •cardiac muscle disease •Selenium/Vitamin E deficiency •trauma/IM injections •infections •drug/lead toxicity	•not significant

(b) Metabolites

PARAMETER	INCREASED	DECREASED
Total Protein	•haemolysis •chronic inflammation •lipaemia •dehydration •aged bird	•acute or chronic disease •parasite burden •hepatic or renal disease •starvation •malnutrition •stress •neoplasia •protein losing enteropathy •chronic haemorrhage/blood loss
Amylase	•pancreatitis •enteritis	•not significant
Urea	•dehydration •ureter blockage (bilateral)	•not significant
Uric Acid	•impaired renal function •starvation •tissue trauma •gout •normal in carnivorous species	•ovulation •severe liver disease
Creatinine	•high protein diet •septicaemia •egg peritonitis •nephrotoxic drugs	•not significant
Glucose	•Diabetes Mellitus •post-prandial •stress •renal neoplasia •ketosis •pancreatitis/peritonitis	•malnutrition •starvation •liver disease •septicaemia •endocrinopathy
Cholesterol	•laying hen •dietary surplus (lipaemia) •neoplasis/lipoma •hypothyroidism •liver disease •starvation •pancreatitis •bile duct obstruction	•dietary deficiency

Total Bilirubin	•haemolytic anaemia •liver necrosis •renal failure	•not significant
Total Bile Acids	•reduced hepatic function •biliary disease	•not significant
Calcium	•egg due to be laid •Vitamin D toxicosis •neoplasia •dehydration	•nutritional hyperparathyroidism •renal failure •African Grey Parrot - idiopathic •excessive egg laying •dietary calcium deficiency •fat necrosis •associated with hypoalbuminaemia
Phosphorus (poor diagnostic value)	•renal disease •enteric disease •cardiac muscle disease •Vitamin D toxicosis •haemolysis •nutritional secondary hyperparathyroidism	•not significant

(c) Electrolytes

PARAMETER	INCREASED	DECREASED
Sodium	•high salt diet •excessive water loss •decreased water intake	•renal disease •severe diarrhoea •polydipsia
Potassium	•haemolysis •renal disease •adrenal disease •acidosis •dehydration •haemolytic anaemia	•chronic diarrhoea •alkalosis
Chloride	•dehydration	•unknown
Bicarbonate	•metabolic alkalosis	•metabolic acidosis

Reference Values

This can be a difficult area to give a single list of values.

If you use an outside laboratory they should supply you with their set of reference values. They will vary from laboratory to laboratory and from species to species. It is recommended that you source more detailed listings in the current literature. There is a very detailed listing of variations with species and ages in the appendix of Ritchie, Harrison & Harrison. Alternately there are lists in Laboratory Medicine by Alan Fudge, Pp. 375-400

Interpretation of Full Blood Count and Biochemistry Profile Results

You should relate any changes to the history and the species disease predilection. The changes in parameter values should fit the disease or they should be ignored. In any biological situation false results may be common.

Use this protocol to help you validate a diagnosis

1. Identify the most important change you can see from the Biochemistry results.

2. Do the other clinical chemistry changes support this?

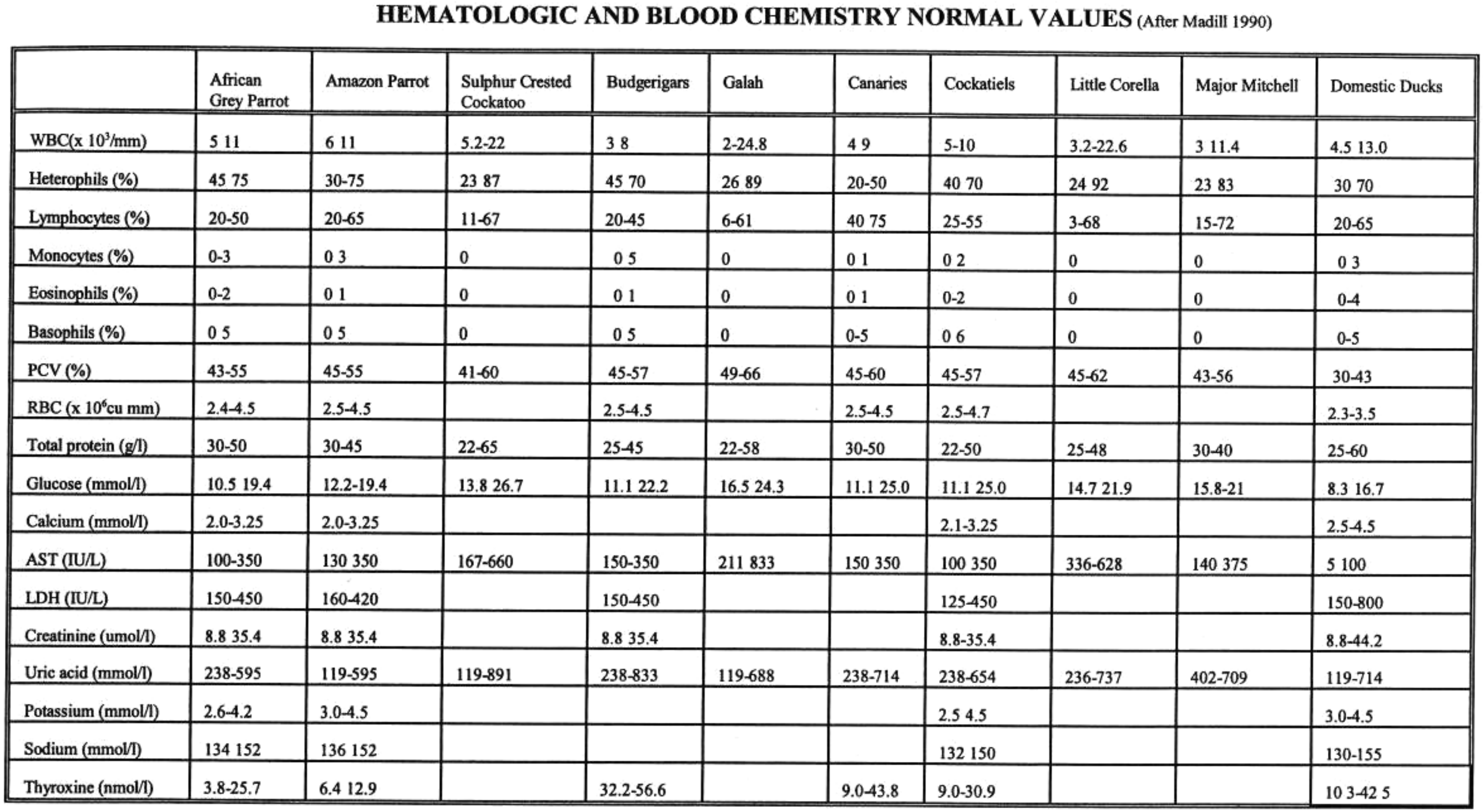
3. If there is greater than one change that is important, consider whether two diseases may be the case.

4. Now consider the haematology. Does it support the changes in the biochemistry?

5. What is the most likely cause of these changes in values?

6. Could this be an artefact? E.g.

- an increased total bilirubin may be from haemolysis
- dehydration will change Na, protein and albumen



HEMATOLOGIC AND BLOOD CHEMISTRY NORMAL VALUES (After Madill 1990)

	African Grey Parrot	Amazon Parrot	Sulphur Crested Cockatoo	Budgerigars	Galah	Canaries	Cockatiels	Little Corella	Major Mitchell	Domestic Ducks
WBC(x 10^3/mm)	5 11	6 11	5.2-22	3 8	2-24.8	4 9	5-10	3.2-22.6	3 11.4	4.5 13.0
Heterophils (%)	45 75	30-75	23 87	45 70	26 89	20-50	40 70	24 92	23 83	30 70
Lymphocytes (%)	20-50	20-65	11-67	20-45	6-61	40 75	25-55	3-68	15-72	20-65
Monocytes (%)	0-3	0 3	0	0 5	0	0 1	0 2	0	0	0 3
Eosinophils (%)	0-2	0 1	0	0 1	0	0 1	0-2	0	0	0-4
Basophils (%)	0 5	0 5	0	0 5	0	0-5	0 6	0	0	0-5
PCV (%)	43-55	45-55	41-60	45-57	49-66	45-60	45-57	45-62	43-56	30-43
RBC (x 10^6cu mm)	2.4-4.5	2.5-4.5		2.5-4.5		2.5-4.5	2.5-4.7			2.3-3.5
Total protein (g/l)	30-50	30-45	22-65	25-45	22-58	30-50	22-50	25-48	30-40	25-60
Glucose (mmol/l)	10.5 19.4	12.2-19.4	13.8 26.7	11.1 22.2	16.5 24.3	11.1 25.0	11.1 25.0	14.7 21.9	15.8-21	8.3 16.7
Calcium (mmol/l)	2.0-3.25	2.0-3.25					2.1-3.25			2.5-4.5
AST (IU/L)	100-350	130 350	167-660	150-350	211 833	150 350	100 350	336-628	140 375	5 100
LDH (IU/L)	150-450	160-420		150-450			125-450			150-800
Creatinine (umol/l)	8.8 35.4	8.8 35.4		8.8 35.4			8.8-35.4			8.8-44.2
Uric acid (mmol/l)	238-595	119-595	119-891	238-833	119-688	238-714	238-654	236-737	402-709	119-714
Potassium (mmol/l)	2.6-4.2	3.0-4.5					2.5 4.5			3.0-4.5
Sodium (mmol/l)	134 152	136 152					132 150			130-155
Thyroxine (nmol/l)	3.8-25.7	6.4 12.9		32.2-56.6		9.0-43.8	9.0-30.9			10 3-42 5

HEMATOLOGIC AND BLOOD CHEMISTRY NORMAL VALUES (After Madill 1990)

	African Grey Parrot	Amazon Parrot	Sulphur Crested Cockatoo	Budgerigars	Galah	Canaries	Cockatiels	Little Corella	Major Mitchell	Domestic Ducks
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Monocytes (%)	0-3	0 3	0	0 5	0	0 1	0 2	0	0	0 3
Eosinophils (%)	0-2	0 1	0	0 1	0	0 1	0-2	0	0	0-4
Basophils (%)	0 5	0 5	0	0 5	0	0-5	0 6	0	0	0-5
PCV (%)	43-55	45-55	41-60	45-57	49-66	45-60	45-57	45-62	43-56	30-43
RBC (x 10^6cu mm)	2.4-4.5	2.5-4.5		2.5-4.5		2.5-4.5	2.5-4.7			2.3-3.5
Total protein (g/l)	30-50	30-45	22-65	25-45	22-58	30-50	22-50	25-48	30-40	25-60
Glucose (mmol/l)	10.5 19.4	12.2-19.4	13.8 26.7	11.1 22.2	16.5 24.3	11.1 25.0	11.1 25.0	14.7 21.9	15.8-21	8.3 16.7
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LDH (IU/L)	150-450	160-420		150-450			125-450			150-800
Creatinine (umol/l)	8.8 35.4	8.8 35.4		8.8 35.4			8.8-35.4			8.8-44.2
Uric acid (mmol/l)	238-595	119-595	119-891	238-833	119-688	238-714	238-654	236-737	402-709	119-714
Potassium (mmol/l)	2.6-4.2	3.0-4.5					2.5 4.5			3.0-4.5
Sodium (mmol/l)	134 152	136 152					132 150			130-155
Thyroxine (nmol/l)	3.8-25.7	6.4 12.9		32.2-56.6		9.0-43.8	9.0-30.9			10 3-42 5

GRANULOCYTES

Contain cytoplasmic granules.

	Heterophil (Mature)	**Heterophil (Immature)**	**Heterophil (Toxic)**	**Eosinophil**	**Basophil**
Shape	Round	Larger & Rounder than mature H	Smaller than mature H	Round, Varied Size	Round, Smaller than H
Cytoplasm	Colourless or faint pink	Bluish	Basophilia Vacuolation Ruptured cells	Bluish	Colourless to light red
Granules	Rod/Spindle shaped pinkish	Round Basophilic-bluish (can confuse with Eosinophil)	Degranulation, Basophilic ++ Magenta rings (end stage toxicity)	Round Pink to bluish	Round Basophilic Intense
Nucleus	Bilobed (2)	Band Nucleus Bean/Round Smooth chromatin	Hypersegmented (>3 lobes)	Lobed/Round Denser than H	Single lobe Intense stain
Increased Numbers	Acute Infection Inflammation Acute trauma Acute blood loss Stress/Steroids Vitamin B1 & B2 deficit	Severe inflammation Bacterial sepsis Egg Peritonitis Chlamydophila	Severe inflammation Severe sepsis	Allergy Parasites – GIT Ectoparasites Haemoparasites Giardia – Cockatiel Tissue trauma Mistake – is really Immature Heterophil	Tissue trauma Chlamydophila Respiratory Disease Resp Parasites Normal – Conures Stress – Fowl Mistake – is actually Toxic Heterophil
Decreased Numbers	End-stage Viral Overwhelming sepsis (from Gram Negs) Normal – Canaries and Amazons Artefact – Smudge Cell	Degenerative L Shift in severe overwhelming sepsis (increased immatures with descreased matures)		Not significant	Not significant
Normal Variant	Macaws – often round granules Conures – often degranulate more				

MONONUCLEAR LEUCOCYTES No granules.		
	Lymphocytes	**Monocytes**
Size	Small & Large smaller than H	Large Cells – larger than H Variable size & shape
Shape	Round or irregular with irregular cytoplasmic projections or blebs	Round, oval or slightly irregular Often mould around adjacent cells Occasional peripheral cytoplasmic projections
Nucleus	Round Definite chromatin clumping	Bean shaped to indefinite Fine lacey chromatin
N:C Ratio	Only Large Lymphocytes have as much/more cytoplasm than Monocytes	Smaller – has more cytoplasm than small and medium lymphocytes
Cytoplasm	Light blue, stippled Small = Large Nucleus:Cytoplasm Large = more cytoplasm	Blue/Grey to pink tinged Ground glass appearance May have 2 zones – outer pale staining and inner more densely staining Large vacuoles – often contains phagocytosed bacteria & debris Often have fine dust-like azurophilic granules
Reactivity	Vacuolation Faint Pink Stippling Blebbing, pseudopodia of cell wall Esp. stress/carrier states/viral/ chlamydophila/mycobacteria/haemoparasites *difficult to distinguish from Monocyte	Vacuolation is normal Phagocytosis Transform to tissue macrophages *difficult to distinguish from Reactive Lymphocyte
Increased	Stress/Steroids Chronic viral infections Chronic inflammation Neoplasis – leukosis, leukaemia Degenerative disease states Granulomatous disease Lymphocytic species: Canary, Finches, Chickens, Amazons	Chronic infections Chronic inflammation Chlamydophila infection Granulomatous disease Aspergillus Mycobacteria Salmonella
Decreased	Acute infections Viral infections – severe Toxins Associated with stress heterophilia Nutritional deficiency Vit A Vit B1 & B2 Folic Acid	Not significant

NOTES:

NOTES:

Chapter 5

Introduction to Avian Radiology

Dr Michael Cannon

This talk will focus on the techniques used to achieve a diagnostic radiograph of a bird. It will also discuss the normal avian anatomical structures you should expect to identify on a radiograph.

Diagnostic imaging is now an important means of diagnosis in all veterinary practices. It includes Computer Tomography (CAT Scans), ultrasound, nuclear scintigraphy and fluoroscopy. The main technique available in most practices is the routine two-view radiographs. This is under-utilised in avian medicine.

The avian air sac system provides a natural contrast that makes it easier to visualise internal organs in avian radiographs than is possible with mammalian radiographs.

Normal protective equipment (gloves, aprons, shields, collimator and radiation monitoring badges) are essential items of equipment for all staff.

RADIOGRAPHIC TECHNIQUE

Choose the lowest kV and the highest mA, with as short as possible exposure time. This is important because of the rapid respiratory rate and relatively small size of most of our avian patients.

Rare earth (high-detail) screens combined with single emulsion film (e.g. mammography film) often give excellent results as long as the exposure time is not increased too much. Alternately, high detail screens with double emulsion film are usually quite successful.

In very small species such as passerines halving the mAs and decreasing the anode-film distance by a quarter will often improve the image.

Collimation is important for all bird radiographs as it reduces scatter and so enhances detail.

Place the film on the tabletop without a grid and place the bird directly on the cassette.

To obtain high quality radiographs we use an automatic film processor. It removes many of the operator errors and results in regular clear films, as it overcomes many of the problems encountered in the manual darkroom. The newer automatic film processors do not require a high volume turnover and are more efficient as well as being economical.

RADIOGRAPHIC POSITIONING

Restraint and correct positioning are vital for high quality radiographs.

In most situations the ideal method of restraint is Isoflurane anaesthesia. It is less stressful than physically restraining the bird, it gives clearer radiographs by limiting movement and it allows staff to be at a safer distance. I routinely use isoflurane anaesthesia for all my avian patients being radiographed.

Multiple pieces of masking tape or a perspex restraining device are the most common means of positioning the bird.

Using masking tape, to restrain and position the bird, can be successful. Some people use masking tape on a conscious bird to restrain it directly onto the cassette. My preference is strongly towards using gaseous anaesthesia as I am convinced it is safer (even in an ill bird) and it removes a lot of stress from the patient, as well as allowing much more precise positioning of the patient. Use generous amounts of ordinary sticky tape or masking tape across the extended wings and legs and neck. Vigorous birds, if conscious, may need additional tapes (another reason to recommend anaesthesia). Elastoplast or similar is also effective but may damage feathers on removal and may reduce detail. **Do not tape across the chest of the bird, as this will interfere with respiratory movement**.

The perspex restraining device consists of a flat piece of clear perspex approximately 50cm square. Attached to it is a structure similar to the stocks used in Medieval England as a restraint device for criminals. It fits over the neck of the bird to position the head. As well there are two devices for extending each leg by attaching to the tarsometatarsus. With slight tension applied these restraints also help to avoid rotation. Masking tape is used to position the wings. Foam rubber blocks can be used to aid this as well.

In some cases, a survey DV radiograph to establish specific information is required (e.g. presence of an egg, bullet or heavy metal density in GIT). Simple restraint such as placing the bird in a roll of cardboard, paper roll, cloth bag or piece of stocking knotted at both ends will suffice.

Take extra care with restraining birds as compared to mammals, because respiratory distress, fractures or other injuries may be exacerbated. Be extremely careful with birds that have a distended abdomen as they have compromised respiration, because the space occupying material (tumour, foreign body or fluid) reduces the ability of the air sacs to expand.

The most standard positions used for radiography of the avian patient are the ventrodorsal view (VD) and right lateral recumbency view. In most instances, because of the size of the patient, this will be a whole body radiograph.

If the positions are standardised, this allows you to interpret the radiographs more efficiently. Use the following standard recommendations for positioning. Following are some simple line diagrams. I have drawn to demonstrate positioning and some of the structures you should be able to identify.

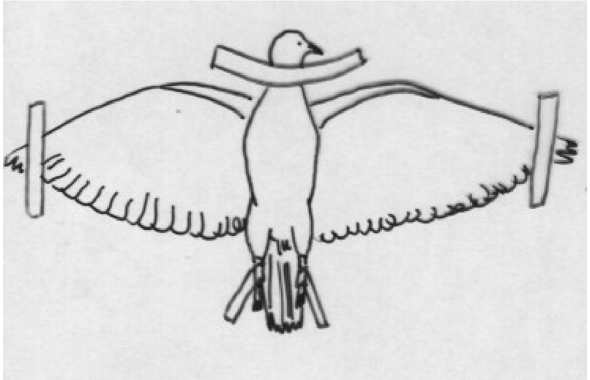


Figure 1. Using masking tape for VD view positioning

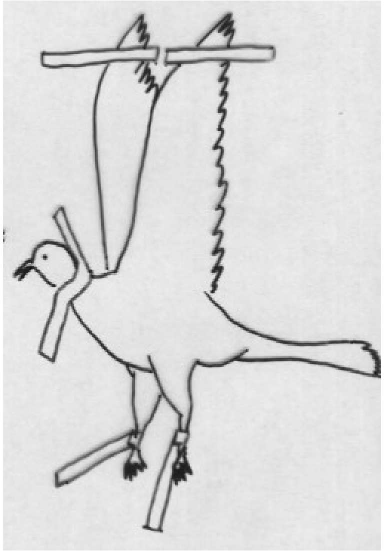


Figure 2. Using masking tape for lateral view positioning

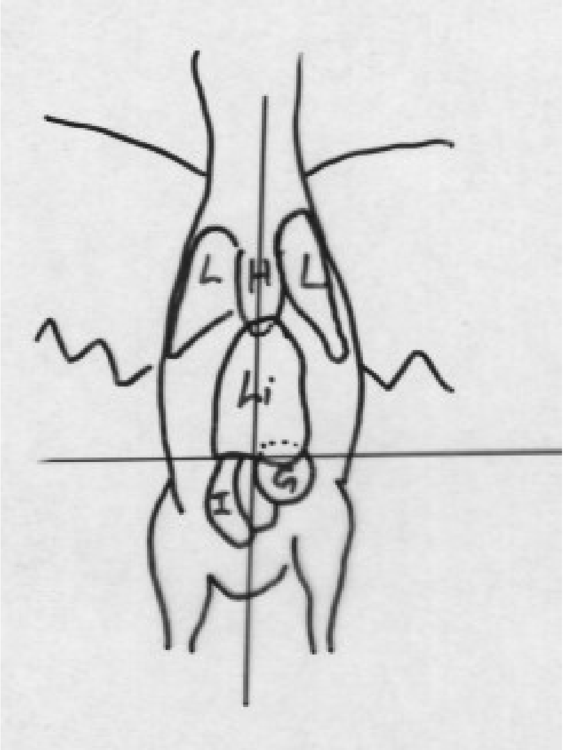


Figure 3. Common radiographic structures VD view

L = lung, H = Heart, Li = Liver, G = Gizzard, I = Intestinal loops

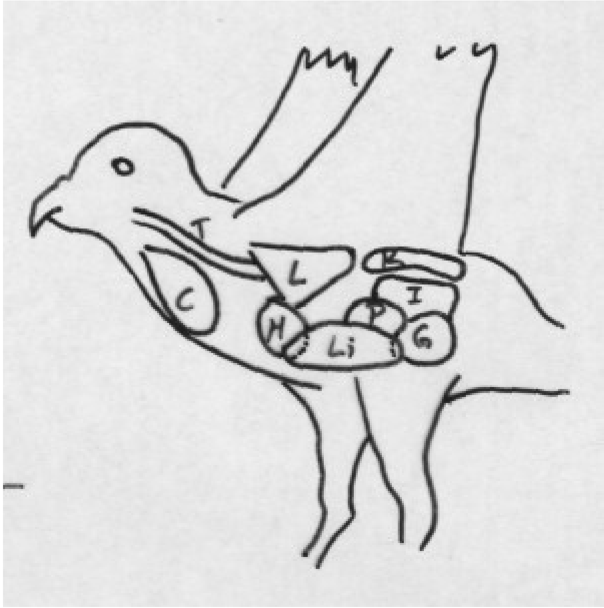


Figure 4. Common radiographic structures VD view

C = crop, T = Trachea, L = lung, H = Heart, Li = Liver, G = Gizzard, I = Intestinal loops, K = Kidney, P = Proventriculus

Whole Body Radiographs

Ventrodorsal (VD) view: Place the bird in dorsal recumbency

- position the keelbone over the spine
- position the patient so scapulae, acetabula and femurs are parallel
- head
  - restrain just below mandible
  - position beak centrally
- wings
  - extend at 90^o from the body, laterally
  - secure with masking tape at carpus
- legs
  - extended caudally
  - parallel to the body
  - secure at tarsometatarsus

Lateral view: Place the bird in Right Lateral recumbency

- position the keel bone parallel to the XR plate
- ribs, coracoid, kidneys and acetabula should be superimposed
- head
  - restrain just below mandible
  - beak parallel to XR plate
- wings
  - extended at 90^o from the body, dorsally
  - foam block separates wings, if required
  - left wing slightly caudal to right wing
- legs
  - extended caudally and ventrally
  - dependent leg slightly cranial - secure at tarsometatarsus
  - if the area of interest is the cloaca or caudal abdomen, extend the legs cranially and ventrally
  - an alternate view is to have the upper leg pulled cranially and resting on a foam support so the femur is parallel to the table while the dependent leg is positioned caudally. This removes the two thigh musculature from overlying each other and gives a better view of the caudal coelom, but it may restrict the view of the cranial coelom.

Head Radiographs

- Use ventrodorsal and lateral views as above
- Oblique views may be used to assist in visualising some areas of the skull and surrounding structures.

Limb Radiographs

- Use ventrodorsal and lateral views as above for limbs but not for antero-posterior view of wings
- Wings are best viewed in antero-posterior by suspending the bird’s body in a vertical position above the table and taping the extended wing to the plate.
- Oblique views are useful for investigations of the coracoid and scapula.

NORMAL PSITTACINE RADIOGRAPH

Many of the radiographs taken in practice are of psittacines as they are generally more expensive and clients tend to have a stronger emotional attachment to them. It is important to appreciate that the normal radiological anatomy can vary between species within the parrot family as well as between the many different avian families. Below are some guidelines for a normal psittacine radiograph (Gill, 1993). If you intend to work with other species, I recommend that you develop a series of normal radiographs to use as a reference, for each species.

Psittacine Whole Body Ventrodorsal View

- The liver and heart form an hour-glass shape referred to as the cardio-hepatic silhouette.
- The lateral boundary of the liver on each side should not extend beyond a line drawn from the medial edge of the scapula to the centre of the femoral head.
- The gizzard should be found in the lower left quadrant of the abdomen.
- The crop tends to lie to the right side of the cervical spine. It is normal for the crop to be empty in the middle of the day.
- The lungs have a regular reticular or honeycomb pattern. If this pattern is clearly evident you have a good quality radiograph.
- The air sacs should be a homogenous black.

Psittacine Whole Body Lateral View

- This is the best view to visualise the kidneys. The ventral edge of the kidneys should not extend below a line drawn parallel to the spine, at the ventral border of the acetabulum.
- Gonads are rarely seen other than during the breeding season.
- The spleen can be visualised as a round structure dorsal to the proventriculus. Splenomegaly is likely if the diameter is more than twice the width of the femur.
- The liver and heart shadows are fused.
- The dorsal border of the heart, liver and gizzard should form a line parallel to the ventral border of the spine.

- It is normal for the gizzard to contain radiodense gravel. To assess the presence of radiodense metal particles in the gizzard, compare the density of the particles to the density of the cortex of the femur - the metal is more radiodense, while gravel is less radiodense.
- An obvious triangular to rhomboidal shaped radiolucent space is found in the area bounded by the heart, lungs, kidney, gizzard and liver. The loss of this space suggests a space-occupying lesion in the abdomen. Use the size, shape, density and position of the other abdominal organs to identify the structures involved.

Hints and Tips:

1. Standardise the way you view each film on the viewer. I prefer to have the birds facing to my left for the Lateral view and in the VD view have the left side placed on my right, as I face the viewer.

2. Before interpreting any film spend a few moment evaluating positioning and exposure.

3. Always examine any film after it has a chance to dry or some fine details may be missed

4. Place the viewer at eye level, preferably in a room that is dimly lit. Allow a few moments for your eyes to adjust to the lighting conditions.

5. Assess your viewer to be certain it has even illumination.

6. Assess each film in a standardised manner. The two common approaches are:

i.organ-by-organ.

ii.Concentric circle system beginning at the centre of the film.

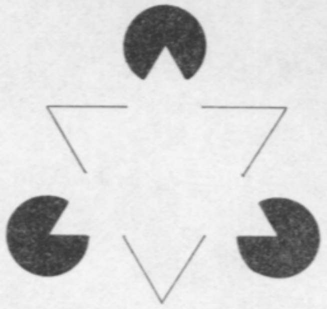
Whichever system you use, always examine the whole radiograph, avoid the temptation to focus on a single lesion.

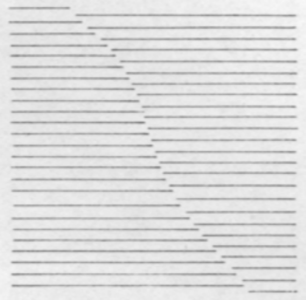
7. Use magnifying lenses or focal lights to examine any interesting areas or lesions. It is amazing what you can see!

Practical Exercise:

Try these following simple exercises to assist in understanding some of the difficulties in interpreting radiographs – they are taken from Grandage, J (1982), *Perception and Psychology of Reading X-Ray Films*. Proceedings No. 59, Refresher Course in Radiology. Post-Graduate Committee in Veterinary Science, University of Sydney. Pp. 251-254. This is a paper I strongly recommend you should all read.

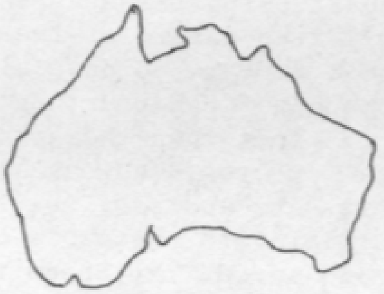
Phantom lines: The eye and brain often make mistakes when trying to organise input and sensations. They will complete parts of figures with lines that do not exist. This will cause you to interpret artefactual changes incorrectly. Always be on the look out for this. Consider the lines that the brain creates from the following images:

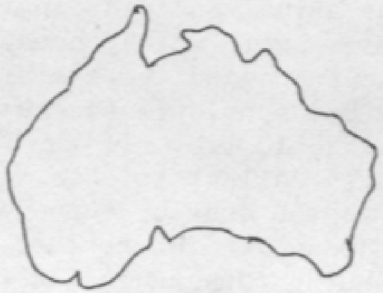


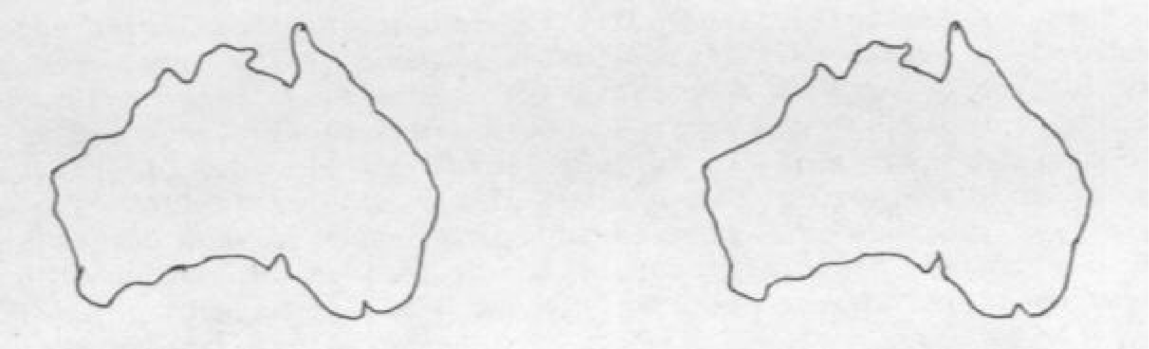


To demonstrate why you should **standardise the position the radiograph** is placed on the viewer, try this quick test: This is an image that you are accustomed to viewing in a particular orientation. If the orientation is changed, interpretation can be more difficult – even with a shape that is very familiar.

Which of the following maps of Australia is more distorted? Turn the page and then interpret the same question with the maps in a more familiar orientation.







To my eye, the left figure is more distorted. What do you think?

This is an interesting case of pattern recognition. It really is more appropriate for Australian participants but you can do the same with any country or other familiar pattern with some minute changes and the result will be the same.

INTERPRETATION

As with all animals, the interpretation of avian radiographs can be limited by;

1. quality of Radiographs

2. knowledge of avian anatomy

3. knowledge of normal radiographic findings

4. knowledge of the radiographic changes which occur in pathological conditions.

AVIAN RADIOGRAPHIC ANATOMY

It is important to recognise the main differences between birds and mammals to aid in radiographic interpretation.

Skeleton

Skull

- No teeth present
- No cranial suture lines
- The infraorbital sinus is quite large and is rostro-ventral to the eyes
- Scleral ossicles form a bony ring to support the eye. These are visible radiographically.

  Parrots have 12 ossicles in each eye.

Thoracic & Pelvic limbs

- Pneumatic bones have air sac extension into the medulla Found in varying proximal portions of the humerus, femur and tibiotarsus. Because of this air space the medullary cavity in these bones should be darker as far as the air space penetrates
- Sternum large and keeled for attachment of pectoral muscles
- Fusion of limb bones produces a common bone such as
  - tibiotarsus
  - carpometacarpus
  - tarsometatarsus
  - clavicles form the Furcula (or more commonly known as the wishbone).

- Ulna is larger than radius. Flight feathers have a close attachment to the periosteum of the ulna, this may be seen radiographically on larger birds such as pelicans.
- Carpus is represented only by radial carpal bone and ulnar carpal bone. The distal carpal bones form the proximal part of the fused carpometacarpus.
- Three digits remain: the alula (I), the major digit (II) and the minor digit (III).
- The pelvis is composed of the fused ilium and ischium and the unfused pubis, so the pubic symphysis is absent.
- There are no epiphysial centres of ossification in any of the wing bones or femur.
- There is no tarsus. The proximal tarsal bones are fused to the tibia to form the tibiotarsus and the distal tarsal bones are fused to the metatarsus to form the Tarsometatarsus.
- Tibiotarsus and tarsometatarsus have epiphysial centres of ossification similar to mammals.
- The nutrient foramen is absent in a bird's bones, so any lesion that resembles a hair line fracture is likely to be a hairline fracture and not a nutrient foramen.

Spine

- Vertebral sections variably fused
- The number of cervical vertebrae varies with species:
    - Most have 12 vertebrae,
    - Budgerigar has 11
    - swans have 25

Respiratory System

- Numerous air filled spaces
  - air sacs
  - pneumatic spaces in bones
- No diaphragm (thorax and abdomen are continuous and is correctly referred to as the coelomic space or cavity)
- Trachea usually passes down Right side of neck on VD view variations can effect position & shape of trachea e.g.:
  - Magpie Geese - coils of trachea found between skin and pectoral muscle mass
  - Cranes & Swans - tracheal coils found within evacuated sternal area
  - Some male ducks - have bulb or bulla at tracheal bifurcation
- Prominent nasal sinuses
- Normal thoracic and abdominal air sacs are clear and well marked
- Parrots have cervicocephalic air sac on dorsocaudal aspect of skull
- Lungs are slightly more dense than the air sacs
  - positioned ventrodorsally in the anterior and lateral thorax.
  - look for reticular or honeycomb pattern due to "end-on" view of
  - parabronchi. (this is a reliable sign to determine a good radiographic exposure)

Cardiac

- Cardiac silhouette extends from rib 2-6.
- Width of cardiac silhouette at the heart base should be approximately 50% of the total width of the coelomic space
- Cardiohepatic silhouette forms an hourglass shape on VD view. It should be wider at the hepatic (distal) segment in a normal bird.
- Other than congenital defects, primary heart disease is uncommon

Digestive System

- Extends from beak via cervical oesophagus to crop at the thoracic inlet, thoracic oesophagus to proventriculus, gizzard (ventriculus), small intestine, caeca (if present), large intestine and cloaca
- Crop
    - present at right lateral aspect of thoracic inlet (can vary with species)
    - size varies with species
    - is food present?
    - may be empty
    - starvation
    - secondary to other disease
    - distended ?
    - foreign body
    - tumour
    - impaction
    - absent in some species e.g. owls, canaries
- Proventriculus
    - visualised best on lateral view
    - positioned in the posterior thorax/anterior abdomen
    - dorsal to liver
    - on VD view it lies to the left of the crop, often covered by
    - cardiohepatic silhouette.
    - when distended, it may change shape of cardiohepatic silhouette
- Gizzard (Ventriculus)
    - visible on lateral view, caudoventral to proventriculus
    - VD view - found at the level of the acetabula in the ventral abdomen
    - about the level of the acetabula to the left of the midline
    - this is the most obvious abdominal organ
    - note presence of 'grit' - small stones, sand and other radio opaque materials
    - Changes in gizzard position may indicate space occupying lesions

- Liver and viscera
    - outlined by air sacs

- Neonates
    - the GIT is more distended than in an adult bird, with fluid and food, until the bird is weaned and independent
    - Proventricular dilatation in a newly weaned or juvenile is abnormal and should be investigated

RADIOGRAPHIC CHANGES

The prominent signs for each of the following conditions can be used to aid in diagnosis and interpretation of your radiograph.

1. Skeleton

i. Fractures

- **Traumatic or pathological?**

location

joint involvement

periosteal reaction

bone density

soft tissue involvement

simple vs comminuted

open vs closed

- **Chronic fracture**

rounding, flaring and indistinct fracture ends

periosteal reaction and soft tissue involvement minimal

- **Healed fracture**

  fracture line not visible

  smooth callus covering all cortices

- **Delayed union with infection**

  regions of lysis and sclerosis

- **Sequestrum of devitalised bone**

  increased bone density

ii Metabolic bone disease

- more common diagnosis than trauma, infection and neoplasia of skeleton
- changes in size, shape and length of bones
- generalised osteopenia (thicker cortices, poor mineralisation - loss of opacity)
- folding fractures (from osteomalacia)
- bowing of tibiotarsi, splay leg, valgus deformity
- kyphosis, scoliosis, lordosis, sternal compression

iii Infection or Neoplasia

- **Osteolysis -** need biopsy to differentiate
- **Acute infection**
  - bone destruction with minimal periosteal reaction
- **Chronic infection**
  - bone destruction with periosteal reaction
- **Fungal Osteomyelitis**
  - pronounced periosteal reaction
  - granuloma causes increased intramedullary density
- **Bone Tumours**
  - bone destruction with minimal periosteal reaction
  - usually proximal humerus, maxilla and wing tips

iv Arthritis

- loss of detail of joint surface
- joint effusion - perform arthrocentesis
- loss of joint space
- epiphysis/metaphysis - lysis and periosteal reaction
- most common in distal joints

v Degenerative Joint Disease

- joint effusion - perform arthrocentesis
- loss of joint space
- more chronic reaction
    - periarticular lipping
    - sclerosis of subchondral bone
    - presence of osteophytes

vi Pre-ovulatory Hen

- diffuse, increased intramedullary bone density (increased opacity)
- mottled appearance (polyostic hyperostosis)
- also reported in oviduct tumours or sertoli cell tumours
- Affected bones:
    - Wing - humerus, radius & ulna
    - Leg - femur, tibiotarsus

2. Cardiovascular System

i Cardiac disease

- primary disease is rare in birds
- secondary disease more common
- main signs:
    - asymmetrical cardiohepatic silhouette
    - cardiomegaly
        - elongation of silhouette
        - loss of caudal and cranial waist
        - loss of indentation at cardiohepatic junction
        - increase in size of atrial shadow

ii Pericardial effusion

- symmetrical round cardiac silhouette
- associated with
    - polyomavirus
    - chlamydiosis
    - neoplasia
    - tuberculosis

iii Atherosclerosis

- increased density of caudal lungfields
- mineralisation of great vessel walls
    - Great Vessels (esp. dorsal to heart base) are more prominent

iv Cardiohepatic Silhouette

- Enlarged cardiac region
    - Pericardial Effusion (see above)
    - Poxvirus
    - Chronic Anaemia
    - Endocarditis
    - Haemochromatosis (not common in Australia)
    - Cardiac Valve degeneration/damage
    - Cardiac compression from extrinsic mass
- Diminished Cardiac region (Microcardia)
    - Hypovolaemia
    - Severe Dehydration
- Prominent/Enlarged Blood Vessels (Atherosclerosis)
    - Very young bird
        - hand-reared?
        - check the diet contents
        - examine kidney carefully
    - Bird on high-fat diet

3. Respiratory System

i Sinuses and Skull

- increased density
    - hypovitaminosis A (caseous exudate)
- osteolysis
    - aspergillosis
    - *mycobacterium*
    - cryptococcosis

ii Trachea

- changes in diameter
    - external or internal masses
        - bacteria
        - fungi
        - foreign body
        - neoplasia
        - parasites
        - hypovitaminosis A
        - goitre

iii Lungs

- normal honeycomb pattern more apparent on inspiration
    - parabronchial infiltration
        - enhanced honeycomb appearance
        - e.g. pneumonia
        - more prominent at hilus and mid-lungfields
    - caseous exudate
        - blotchy, mottled appearance, especially at caudal aspects of lungs
    - VD view is best to detect
        - pulmonary oedema or haemorrhage
            - uniform increase in lung density
            - more diffuse than pneumonia
        - discrete, well-defined mass or masses
            - abscess, granuloma or tumour

iv Air Sacs

- should be evenly black
- juvenile birds and neonates normally have dense abdomen and very little air sac space
- size increases with inspiration and decreases with expiration
    - air-sacculitis
        - hyperinflation of thoracic and abdominal air sacs
        - appears as fixed full inspiration

    - diffuse thickening
        - fine lines across air sac shadows
        - increased opacity of air sac fields
        - best visualised on lateral view
        - consolidation of air sacs
    - loss of clear visualisation of viscera
    - diffuse heterogenous appearance
    - air/soft tissue interface hazy

v Subcutaneous Emphysema

- differentiate by site and other tissue damage
    - ruptured air sac
    - secondary to rib or coracoid fracture
    - damage to pneumatic bones
    - infraorbital sinus infection
        - Make sure this is not actually hyperinflation of an air sac rather than subcutaneous emphysema

4. Abdomen and Gastrointestinal System

i Oesophagus

- seed present in oesophagus = likely an obstruction
- perform crop wash look for Trichomonas

ii Crop

- look for distension or displacement.
- absence of food in crop with plenty available is a poor prognostic sign
- food present in a parrot’s crop in the middle of the day usually indicates a slow emptying crop

iii Spleen

- best visualised on lateral view
- caudal and just dorsal to proventriculus
- may be round or elongated
- diameter should be less than twice the width of the femur
- approximate normal sizes

budgerigar	1mm
medium parrot	6mm
cockatoo	8mm

- splenomegaly
  - can be visualised as above on lateral view
  - on DV view it is in midline just cranial to the pelvis (often difficult to visualise)

iv Gizzard (Ventriculus)

- normally in lower left abdominal quadrant
- dorsal border of heart, liver and gizzard form a straight line parallel to the ventral border of the spine
- normally contains radiodense gravel or grit
- lack of grit may indicate
  - hypermotility
  - enteritis
  - no grit available in diet
  - presence of grit in proventriculus is a poor prognostic sign

v Liver

- Hepatomegaly is a common problem in psittacines
- lateral view
  - caudal liver shadow extends beyond sternum
  - dorsal elevation of proventriculus
  - caudo-dorsal displacement of gizzard
- VD view
  - extends beyond line drawn from coracoid to acetabulum

    - loss of hourglass shape to cardiohepatic silhouette
    - lateral compression of abdominal air sacs
    - cranial displacement of heart shadow
    - caudal displacement of gizzard
        - symmetrical enlargement
            - infectious cause
            - metabolic cause (especially obesity)
        - asymmetrical enlargement
            - neoplasia
            - granulomatous disease

Use contrast media to differentiate enlarged liver from enlarged proventriculus

vi Gastrointestinal Tract

- Best evaluated with contrast medium
- normally occupies:
    - VD: right lower abdominal quadrant
    - Lateral: caudal, dorsal abdomen

Signs to look for

- Distension with fluid is abnormal
- presence of gas (any gas present is abnormal)
    - hypermotility - commonly parasites e.g. Ascarids
- displacement or change in position
- neoplasia (spleen, testis, ovary, kidney)
    - VD: cranially or caudally displaced GIT
    - lateral: ventrally displaced GIT
- hepatomegaly
    - VD: caudal displacement of gizzard
    - lateral:
        - dorsal displacement of proventriculus
        - caudo-dorsal displacement of gizzard
        - adhesions secondary to peritonitis
        - variable displacement of GIT

- Abdominal effusion
    - homogenous appearance to abdomen
    - distended abdomen
    - VD: proventriculus and gizzard displaced cranially
    - lateral: liver displaced ventrally

vii Diffuse Density in Caudodorsal Abdomen

Possible Causes

- enlarged kidneys
- male in breeding condition
- other causes of enlarged testes (neoplasia)
- female in breeding condition
    - enlarged oviduct
    - can usually visualise active ovary
    - seen as a bunch of grapes cranial to kidney
- neoplasia
    - spleen
    - testis
    - ovary/oviduct
    - kidney
    - intestines

5. Urogenital System

i Kidneys

- best visualised in lateral view - 3 lobes
- cranial pole of kidney is seen at cranial edge of pelvis in VD view
- should not extend below a line drawn parallel to spine and through
    - ventral border of acetabulum
- normally surrounded by an air space
    - loss of this air space suggests enlargement
- increased renal density
    - dehydration
    - heavy metal toxin

- enlarged kidneys
    - bilaterally symmetrical enlargement
    - infection
    - metabolic disease
    - post-renal obstruction
    - lympho-reticular neoplasia
    - dehydration
    - localised enlargement (differentiate with biopsy)
    - neoplasia
    - renal abscess
    - renal cyst
        - solitary mass with well defined borders

ii Gonads

located ventral to the cranial pole of the kidney

- enlargement (diffuse tissue mass in caudodorsal abdomen, ventral to kidneys) may indicate male in breeding condition
    - enlarged testes
- female in breeding condition
    - enlarged oviduct
    - can usually visualise active ovary, which is seen as a bunch of grapes cranioventral to kidney

Gonadal enlargement is often associated with dyspnoea and unilateral paresis of the leg on the affected side.

iii Female Genital Tract

- enlarged oviduct
    - retained egg
    - mineralised egg is easily visualised in terminal
    - oviduct
    - soft-shelled eggs look like any other soft tissue mass
        - approximately spherical areas of increased density

    - hyperoestrogen syndrome
        - enlarged, distended oviduct
        - intramedullary hyperostosis (mottled appearance)
        - decreased abdominal detail (especially caudodorsal aspect)
        - ventral displacement of viscera
        - abdominal hernia
- Egg Peritonitis (perform abdominocentesis)
    - same as other causes of abdominal effusion
    - homogenous appearance to abdomen
    - distended abdomen

6. Other Conditions

- Foreign Bodies
    - radiopaque
        - usually lead shot, pellet
        - nails, coins or heavy metal particles especially in gizzard.

- Abnormal calcification
    - crop calculi
    - urate deposits in articular gout
    - calcification of blood vessels or other tissues (consider also atherosclerosis)

- Mediastinal densities
    - possibly enlarged thyroid gland with goitre

- Kidney enlargement
    - Tumours primarily

- Abdominal Hernias
    - usually seen as a distended abdomen
    - some loss of detail in the abdominal air sacs
    - gizzard may be displaced caudally

CONTRAST RADIOGRAPHY

The contrast media normally used in mammals are considered safe to use in birds. They may be used for a more detailed visualisation of areas such as the cardio-respiratory system, the gastrointestinal tract and the sub-arachnoid space.

Any ill patients need to be stabilised before such studies may be undertaken. Anaesthesia and sedation are contra-indicated as they may slow passage of the medium, particularly in the gastrointestinal tract. The benefit of the study has to be balanced against its possible stress to the patient.

To aid in visualisation, proper preparation involves the use of survey radiographs prior to contrast studies and fasting for four hours prior to allow the gut to be empty.

For gastro-intestinal tract studies, the contrast medium most suitable is a 25% solution of barium sulphate. The barium solution is introduced directly into the crop using a plastic catheter or stainless steel crop needle. Administer the medium slowly to allow the crop to dilate. The following volumes are suggested.

Species	**Volume of 25% Barium Sulphate (ml)**
Small passerine (e.g. canary, finch)	0.25 - 0.5
Small Parrot (e.g. budgerigar)	1.0 - 3.0
Quarrion or agapornis lovebird	3.0 - 5.0
Rosella	5.0 - 10.0
Cockatoos	10.0 - 15.0

Use this chart as a guide to the sequencing of radiographs for a barium study.

Normal passage time of barium through the gastrointestinal tract is:

Species	**Time (min)**	**Site of Barium**
Budgerigar	O	crop +/- proventriculus
	15 - 30	Crop, proventriculus, gizzard, proximal half of intestines
	60	entire GIT
	240	Crop empty, varying amounts in remainder of GIT
Canary	O	crop +/- proventriculus
	5 - 15	Crop, proventriculus, gizzard, proximal half of intestines
	15 - 30	entire GIT
	30 - 90	Crop empty, varying amounts in remainder of GIT
Racing Pigeon	O	crop +/- proventriculus
	10 -30	Crop, proventriculus, gizzard, proximal half of intestines
	30 -120	entire GIT
	120 -240	Crop empty, varying amounts in remainder of GIT
Cockatoo	O	crop +/- proventriculus
	30 - 60	Crop, proventriculus, gizzard, proximal half of intestines
	60 - 120	entire GIT
	120	Crop empty, varying amounts in remainder of GIT

Air can be introduced into the crop for negative contrast or, following barium, for double contrast studies.

Barium in the GIT will outline not only the gastrointestinal structures but can also enhance visualisation of adjacent structures.

Soluble contrast media such as organic iodides (e.g. sodium diatrizoate, iothalamate sodium or meglumine diatrizoate) may be used to perform an intravenous pyelogram (IVP). The recommended dose is 0.25mL/kg. This solution should be warmed and then may be administered through an intravenous injection (jugular, ulnar or medial metatarsal veins). Radiographs must be taken within 30-90 seconds of injection as the contrast material is rapidly flushed through the kidneys by the renal portal system.

INTRAVENOUS PYELOGRAM (IVP)

Normal sequencing of radiographs

- immediately post injection, then
- 1 minute
- 2 minutes
- 5 minutes
- 10 minutes
- 20 minutes

Normal visualisation is:

10 seconds:	aorta, heart, pulmonary arteries
30-60 seconds:	kidneys and ureters
3-5 minutes:	cloaca

An alternate approach is to administer the organic iodide through an indwelling intraosseous cannula in the proximal tibiotarsus. This gives excellent visualisation of the kidneys.

Other applications of contrast studies include: positive contrast rhinosinography, positive contrast tracheography and bronchography, non-selective angiography, and myelography (via subarachnoid space).

HANDY HINT:

Begin a collection of good quality representative radiographs of different species and body regions that you can use as a handy reference in your practice. Place them in a ring binder or folder with an Index to make access easier. Improve and update this as you develop improved skills and a wider patient basis. Consider it a work in progress that can be available to everyone in the practice.

NOTES:

Chapter 6

Common Avian Disease Syndromes

Dr Michael Cannon

A SELECTION OF COMMON AVIAN DISEASE SYNDROMES LIKELY TO BE SEEN IN A NON-REFERRAL PRACTICE

This paper will not be an exhaustive cover of avian diseases, but will discuss the diseases you could expect to normally encounter in veterinary practice in Australia.

Any avian examination begins with first contact with your practice. Appendix 1 contains an approach to clinical examination that demonstrates how to perform a clinical examination of your patient. You need a structured process to begin your diagnosis and this is a well established method.

In Appendix 2 I have provided a written form to assist in working through this process.

To recognise common problems and refine your differential diagnosis, I have provided a list of common problems seen listed by species in Appendix 3.

Finally in Appendix 4. I have provided a guide to identifying avian species. This is more useful for identifying the multitude of wild species that may present but it also is useful for identifying the genus of the more common parrots held by aviculturists and mentioned in the text – *Neophema, Polytelis, Psephotus* etc.

I have provided a short to discussion of each the common diseases under the headings: Aetiology, Signs & Symptoms, Laboratory Findings, Prevention and Treatment and Control.

INFECTIOUS DISEASES

Viruses

- Psittacine Circovirus - Beak and Feather Disease
- Polyomavirus
- Pacheco’s Virus

Bacteria

- Salmonella & E.coli
- Pseudomonas
- Psittacosis/Chlamydophilosis

Fungi

- Aspergillosis
- Macrorhabdosis (Megabacteria)
- Candidiasis

Protozoans

- Trichomonas
- Giardia
- Coccidiosis

Parasites

- Ascarids
- Capillaria
- Cestodes
- Cnemidocoptes
- Air Sac mite

PSITTACINE BEAK AND FEATHER DISEASE

Aetiology

Viruses of the family Circoviridae

Signs & Symptoms

Signs may vary greatly. Generally a disease of young birds but may appear in older birds.

Feather changes, lesions of the beak and occasionally of the nails are usually symmetrical.

Different forms of the disease seem to be influenced by the age of the bird when symptoms first appear.

***Peracute* – seen in neonates**

- Septicemia
- Pneumonia
- Enteritis
- Rapid weight loss and death

***Acute* - usually reported during first feather formation**

- Depression
- Sudden changes in developing feathers including necrosis, fractures, bending, bleeding or premature shedding of diseased feathers.
- May not show feather symptoms but develop crop stasis and diarrhoea followed by death.

Chronic

- Progressive appearance and abnormally developed feathers during each successive moult.
- Retention of feather sheaths
- Haemorrhage within the pulp cavity
- Fractures of the proximal rachis and failure of developing feathers to ex-sheathe.
- Short clubbed feathers
- Deformed curled feathers
- Stress lines within vanes and circumferential constrictions may also be present.
- Replacement feathers are increasingly abnormal and birds may become bald as feather follicles cease to function.
- Changes in beak: progressive elongation, fractures necrosis and ulceration.

Laboratory Findings

- Basophilic intranuclear and intracytoplasmic inclusion bodies are present by haematoxylin and eosin staining of sections of beak, feathers, thymus and bursa in birds with clinical signs.
- Immuno-histochemical staining with viral specific antibodies is used to confirm intracytoplasmic basophilic inclusion bodies
- DNA probes are used to detect Beak and Feather Disease Virus (BFDV) nucleic acid.
- Haemagglutination tests can be run to determine immunologic response to PBFD virus.
    - Circovirus antibody Titre detected by Haemagglutination Inhibition (HI) test
    - Circovirus antigen Titre detected by Haemagglutination (HA) test

4 possible outcomes:

1. Antibody (HI) positive + Virus Antigen (HA) positive

- Active virus carrier
- May occasionally be a bird that has completely or partially recovered – more common in: Budgerigars, Rainbow Lorikeets, African Lovebirds, King Parrots and Eclectus parrots.

2. Antibody (HI) positive + Virus Antigen (HA) negative

- Has been exposed to BFDV and has recovered
- Consistent with previous disease within an aviary, particularly if it is a closed aviary

3. Antibody (HI) negative + Virus Antigen (HA) positive

- Peracute or chronic psittacine circovirus disease case
- Active carrier
- Unlikely to recover

4. Antibody (HI) negative + Virus Antigen (HA) negative

- Has not been exposed
- Agar gel immunodiffusion tests can detect precipitating antibodies to PBFD virus.

Prevention

- The major routes of infection are from dust from faeces, feathers and from parental feeding of young. Thew virus may be present in all body excretions and secretions as well as shed epithelials from GIT mucosa, skin and feathers
- Any bird which has been exposed to possible sources of infection should not be allowed in the aviary.
- The tests mentioned above such as HA, HI and DNA Probe for BFDV should be used to test all birds of susceptible species to rule out latent infection.
- The DNA Probe can also be used to test the aviary environment and equipment for possible contamination.
- A carrier state is possible.

Treatment

- Stress free environment and supportive medical care.
- Isolation from other susceptible birds.
- No known specific treatment at this time.
- Euthanasia is often recommended

POLYOMAVIRUS

Aetiology

- Polyomavirus and commonly known as Psittacine Papovavirus and Budgerigar Fledgling Disease

Signs & Symptoms

- Depression
- Anorexia
- weight loss
- delayed crop emptying
- regurgitation
- diarrhoea

- dehydration,
- subcutaneous haemorrhages
- dyspnoea
- polyuria
- ataxia
- tremors
- paralysis
- Common at the time of weaning and fledglings usually die 12 to 48 hours after developing symptoms.
- Chronic form has intermittent symptoms.
- Carrier state is possible.

Laboratory Findings

- Staining of lesions using viral specific antibodies or polyomavirus specific DNA probes.
- Immunodiffusion and virus neutralisation can be used to detect polyomavirus antibodies in exposed birds.
- This antibody response is transient and birds revert to sero-negative over a short period of time.
- Best test for birds shedding polyomavirus is a cloacal swab.

Prevention

- Polyomavirus is resistant to severe environmental conditions and many disinfectants.
- Transmission can take place through feather dust and excrement and through parental feeding of chicks.
- Isolate any birds tested to be shedding the virus.
- Interrupt the breeding cycle with a rest of several months since the disease seems to be self-limiting.

Treatment

- No confirmed therapies are known.

CHLAMYDOPHILOSIS

Aetiology

Signs & Symptoms

Laboratory Findings

Prevention

- Regular cleaning and disinfecting program.
- Suggested disinfectants: Benzalkonium chloride, hydrogen peroxide, 1% formalin.
- Prophylactic treatment using member of tetracycline family of drugs

Treatment

- Tetracyclines: Doxycycline is preferred. Some still use Chlortetracycline or Oxytetracycline
- Some people report success with Azithromycin or Enrofloxacin.

BACTERIAL ENTERITIS (COMMONLY *SALMONELLA* AND *E. COLI*)

Aetiology

- Gram negative bacteria most often coliforms, *Salmonella* and *E.coli*.

Signs & Symptoms

- Ruffled feathers - diarrhoea - listlessness - weakness - shivering - vent picking
- The severity of the illness depends on the age of the bird, the virulence of the bacteria, stress and the degree of contamination.

- Affected birds may be carriers showing no disease symptoms. These carriers may spread the disease to their offspring and may become acutely ill as a result of stress.
- Baby birds, with their less developed immune systems, are usually acutely ill and frequently die.
- Chronic infections in adult birds may form abscesses, fail to hatch eggs, have changes in eating habits and may intermittently pass contaminating bacteria.
- In *Salmonella*, droppings are coloured a Sulphur yellowish green which is very much a diagnostic sign for this microorganism.

Laboratory Findings

- Live bird: Several specimens of faecal material or blood collected over several days are cultured in order to identify the bacteria involved.
- Dead bird: intestinal contents, liver, blood and spleen are also cultured. Sensitivity testing should be performed since enteric bacteria are often resistant to several antibiotics.

Prevention

- Keep water and feed dishes free of faecal material.
- Identify and cull carrier birds.
- Control contact of the aviary or bird with outside birds.
- Careful disposal of contaminated materials.
- Minimise Stress.
- People working with contaminated material should practice good hygiene.

Treatment

- Start treatment at once based on clinical signs.
- Injections and oral fluid replacement is often necessary. Lactated Ringer's solution is best.
- Broad-spectrum antibiotics should be started when the culture is taken. Oral and injectable antibiotics should be given simultaneously in severe cases.

- The sulfa drugs are good to use orally. Kanamycin and Gentamicin are usually effective by injection. When Gentamicin is used do not allow dehydration or renal toxicity may occur.
- If necessary, the antibiotics can be changed after sensitivity test results are known.
- If diarrhoea is severe Kaopectate or Pepto-Bismol may be given orally with 2 to 3 drops in mouth three times per day.
- Water consumption should be monitored to prevent dehydration.
- Maintain a stress free environment.
- An incubator or a heating pad under the cage should be used to maintain the temperature between 30 °-32° C. If the heating pad alone won't maintain the temperature, place the cage in a box and the box on a heating pad with a thermometer in the back of the box in order to monitor temperature.

PSEUDOMONAS

Aetiology

- Gram negative rod, *Pseudomonas aeruginosa*
- The species are mainly secondary invaders; once established they produce toxins that can be life threatening.

Signs & Symptoms

- Diarrhoea, dehydration and dyspnoea followed by death
- skin lesions
- localised infections in upper respiratory tract (rhinitis, sinusitis & laryngitis)

Laboratory Findings

- Growth of bacteria on common media (MacConkeys & Endo plates)
- Causes Beta-haemolysis on blood plates.
- Produces a blue-green diffusible pigment and has a sweetish odour.

Prevention

- *Pseudomonas* outbreaks in the aviary usually are caused when organic matter contaminates the water allowing proliferation of the organisms.
- Routine cleaning of food and water containers and any water pipes involved in automatic watering systems is critical.
- Cleaning water reservoirs in incubators is important in preventing contamination.

Treatment & Medication

- The organism is resistant to many commonly used antibiotics. Prevention is therefore most important
- Chlorhexidine is not effective against *Pseudomonas*.
- Piperacillin, Ticarcillin and Tobramycin may be used in the absence of culture & sensitivity results.

COCCIDIOSIS

Aetiology

- An enteric infection by one of the host-specific coccidia.
- Genera: *Eimeria, Isospora*, *Caryospora*, *Tyzzeria*,*Wenyonella.*
- Not all species are pathogenic, so birds may be asymptomatic carriers.

Signs & Symptoms

- Diarrhoea with or without blood and mucous.
- Weight loss
- Anaemia
- Dehydration
- Depression
- Ataxia
- Incoordination
- Sudden death
- Soiled vent and swollen abdomen
- Faeces ranges from bloody and greenish to watery and brown.

Laboratory Findings

- Impression smears of intestinal contents at Post-mortem examination or faecal flotation will reveal oocysts.
- Diagnosis may be more difficult in Budgerigars as they often are ill before they reach the oocyst producing stage.

Prevention

- Cleanliness of the environment, food and water is most important.
- Overcrowding may also contribute to infection.
- Do not mix young birds with adults

Treatment & Medication

- Advanced cases are difficult to treat and often result in death.
- Coccidiocides:
  - Baycox (Toltrazuril) 25mg/ml. Use 3ml per litre drinking water for 3 days.
  - Amprolium + Ethopabate

MACRORHABDOSIS (MEGABACTERIA ASSOCIATED DISEASE)

Aetiology

- A yeast infection of the outflow of the Proventriculus by *Macrorhabdus ornithogaster*, formerly known as Megabacteria.
- Can affect psittacine and non-psittacine birds
- Not all species are pathogenic, so birds may be asymptomatic carriers.

Signs & Symptoms

- SBL (Sick Bird Look)
- Chronic wasting disease
- Neck-stretching and vomiting (usually mucous covered seed, but may also contain blood)
- Droppings range from slightly loose to diarrhoea (soft, watery, bulky), occasionally dark and tarry.
- Polyphagia - Birds appear to have a ravenous appetite but close observation reveals that they are not swallowing the seed.
- Acute form: die within a few days
- Chronic form: become progressively emaciated and debilitated over weeks to months and may die or appear to recover then died when they relapse weeks to months later

Laboratory Findings

- A rod-shaped to filamentous organism, Gram positive and Periodic Acid-Schiff (PAS) positive.
- Commonly located at the junction of proventriculus and ventriculus at post-mortem examination.
- Gram stain or wet mount
    - Impression smears of proventricular outflow at Post-mortem examination
    - faeces (f not apparent on first sample, repeat on pooled faecal samples collected over 5 days)
    - on crop aspirate or vomitus

Prevention

- Quarantine and examine droppings of all new arrivals
- Avoid mixing Budgerigars, European Goldfinches (*Carduelis carduelis*) and European Greenfinches (*Carduelis chloris)* with other birds.
- Reduce stress
- Remove eggs from infected parents and foster under non-infected birds is successful in preventing transmission

Treatment & Medication

- Amphotericin B orally for 30 days 100mg/kg PO q12h.

HELMINTH PARASITES OF ALIMENTARY SYSTEM

1. Ascarids

Aetiology

- *Ascaridia* species.
- Common in psittacines (especially Australian parrots), poultry and wild birds
- Can cause intestinal blockage or rupture in parrots, particularly budgerigars, Princess parrots (and other members of the *Polytelis* genus), grass parrots (*Neophema* and *Psephotus*), Rosellas and Major Mitchell's cockatoos.
- They are relatively large (3-5cm long) and easily located at post-mortem examination.

Signs & Symptoms

- SBL (Sick Bird Look)
- Droppings range from slightly loose to diarrhoea (soft, watery, bulky), occasionally dark and tarry.
- Polyphagia – some birds have a ravenous appetite Acute form: die within a few days

Laboratory Findings

- Routine faecal flotation is usually diagnostic as they shed large numbers of typical ascarid eggs. Eggs may not be apparent if the ascarids are all juvenile and not yet egg producing.

Prevention

- Quarantine and examine droppings of all new arrivals
- Avoid mixing budgerigars, Princess parrots (and other members of the *Polytelis* genus), grass parrots (*Neophema* and *Psephotus*), Rosellas and Major Mitchell's cockatoos with other birds.

Treatment & Medication

- Fenbendazole (Panacur 25, 25mg/ml) 25-50mg/kg PO sid x 3-7 days, or 100mg/kg PO once.
- Levamisole (many brands) 15mg/kg PO once
- Oxfendazole (Oxfen LV, 45.3 g/L) 20mg/kg PO once or 2.5ml/L Drinking water
- Ivermectin (Ivomec 0.8g/L) 0.1cc/100g PO by gavage needle

2. Capillaria

Aetiology

- *Capillaria* species: *C. annulata*, *C. contorta* and *C. obsignata* are parasites of crop and oesophagus of pheasants, quail, ducks and turkeys. Also a problem in pigeons, African Lovebirds and South American Conures.
- Adult Capillaria cause damage by burrowing under the epithelium creating inflammation and haemorrhage. The eggs cause a local inflammatory response and are released with the sloughed mucosa.
- They are relatively small and easily overlooked at post-mortem examination.

Signs & Symptoms

- SBL (Sick Bird Look)
- Weight Loss and diarrhoea
- Pigeons have poor performance in races

Laboratory Findings

- Routine faecal flotation may not be diagnostic with normal salt solutions
- Eggs are intermittently shed in only small numbers. Typical bipolar eggs.
- Use repeated wet mounts to detect the eggs.

Prevention

- Quarantine and examine droppings of all new arrivals

Treatment & Medication

- Moxidectin (Cydectin Oral Drench 1g/L) 400-1000 mcg/kg PO
- Oxfendazole (Oxfen LV, 45.3 g/L) 20mg/kg PO once or 2.5ml/L Drinking water
- Levamisole (many brands) 15mg/kg PO for 3days

3. Cestodes

Aetiology

- *Choanotaenia* (finches), *Raillietina* (poultry) and other host-specific species
- Tapeworms are an uncommon problem and most infestations involve only small numbers of the parasite that do not harm the host.
- They are more common in finches, cockatoos and racing pigeons.
- The adult tapeworm lives in the lumen of the intestine and segments are shed with the faeces. These segments are usually ingested by a range of intermediate hosts - arthropods, molluscs or annelids.
- They are easily seen at post-mortem examination.

Signs & Symptoms

- SBL (Sick Bird Look)
- Weight Loss and depression
- Occasionally segments can be seen protruding from the bird's vent.

Laboratory Findings

- Routine faecal flotation are not diagnostic with normal salt solutions

Prevention

- Quarantine and treat all new arrivals
- Use insecticides such as pyrethrins to control possible intermediate hosts, by spraying the environment – especially small cracks that provide protection.

Treatment & Medication

- Praziquantel
- Niclosamide
- Fenbendazole

CNEMIDICOPTES (SCALEY FACE OR SCALEY LEG MITE)

Aetiology

- *Cnemidocoptes pilae* (budgerigar, canary and parrots) and *C. mutans* (poultry) – causes bird mange
- Can affect domestic chickens and other galliformes, Canary, budgerigar, pigeons, Kakariki, Neophemas, cockatoos
- Common name is different in some species:
    - Scaley face in Budgerigar
    - Scaley leg in chicken
    - Tassle foot in canary (elongated encrustations on legs and plantar aspect of feet)

Signs & Symptoms

- The mites burrow under the epithelium causing raised white to yellow crusting and honeycomb-like encrustations on cere, eyelids, beak and legs. Occasionally cause encrustations at elbows, vent and skin (commonly apterylae of wings).
- In budgerigar often causes beak deformity and anorexia
- May resemble flour on the skin of Sulphur-crested cockatoos.
- Some birds with the problem on feet may be lame and develop secondary bacterial or fungal infections

Laboratory Findings

- Crush preparation of encrustations in oil will reveal the mite

Prevention

- Quarantine and examine droppings of all new arrivals
- Avoid mixing Budgerigars, European Goldfinches (*Carduelis carduelis*) and European Greenfinches (*Carduelis chloris)* with other birds.
- Reduce stress
- Remove eggs from infected parents and foster under non-infected birds is successful in preventing transmission

Treatment & Medication

- Moxidectin 200 mcg/kg PO once weekly until controlled
- Ivermectin 400-1000 mcg/kg PO once weekly until controlled

AIR SAC MITE

Aetiology

- *Cytodites nudus* and other sarcoptiform mites.
- Can affect passerine birds (finches and canaries) as well as other birds – turkey, pheasant and domestic chicken.
- Most common in Canary, Gouldian Finches, European Goldfinches and Cordon Blue Finch.

Signs & Symptoms

- Respiratory signs are present only in severely affected birds
- Transilluminate trachea: (spray overlying feathers with methylated spirits and then shine a bright light source through the skin overlying the trachea) see tiny red dots moving within the tracheal lumen
- Respiratory "click" apparent with careful auscultation or if you stand still in an aviary on a quiet evening.

Laboratory Findings

- They are difficult to visualise on post-mortem examination (use magnification and examine trachea and air sacs carefully.
- Easily missed histologically.

Prevention

- Quarantine and treat all new arrivals

Treatment & Medication

- Ivermectin 400-1000 mcg/kg PO once weekly until controlled, (Ivomec for sheep, 0.8g/l) 1 drop into the beak once weekly until controlled
- Moxidectin 200 mcg/kg PO once weekly until controlled
- Pyrethrin spray into a localised area for the birds to inhale. Repeat weekly.

ASPERGILLOSIS

Aetiology

- *A. fumigatus*, *A. flavus* and *A. niger*

Signs & Symptoms

- Emaciation
- respiratory distress
- neuromuscular disease
- abnormal droppings
- regurgitation
- voice changes
- poor appetite
- nasal discharge
- gout
- conjunctivitis

Laboratory Findings

- Fungal culture and identification combined with presence of lesions.

Prevention

- Minimise stress and overcrowding.
- Malnutrition from lack of proper diet.
- Poor ventilation.
- Disinfectant fumes, cigarette smoke, ammonia, and other toxic chemicals
- Transmitted by spores, which are often present in the environment.
- Healthy unstressed birds are generally resistant to fairly high concentrations of spores.
- Young, old, unhealthy and those on antibiotics or corticosteroid therapy are frequently infected.
- Reduce contact with nesting materials, etc which may be contaminated with mould or spores.
- Feed should be free of fungal growth. May be found in corn and grain products as well as manufactured pellets or extruded food. Improper storage of these food products will greatly increase contamination.

Treatment & Medications

- Removal of stress factors.
- Combinations of Flucytosine, Fluconazole and Itraconazole are recommended.

CANDIDIASIS

Aetiology

- *Candida albicans*, a yeast.

Signs & Symptoms

- General unthriftiness, increased appetite, vomiting and weight loss, especially in babies.
- May affect crop and oral mucosa, intestines, eyes, lungs.
- Lesions are raised white patches that are easily removed with a cotton swab.
- The underlying mucosa is thickened and roughened and therefore cannot function properly.
- Rhinitis and beak necrosis may also occur if the yeast infects the otopharynx and spreads to the nares or the upper beak causing the lower beak to grow abnormally.
- Crop and oesophagus contains lesions.

Laboratory Findings

- Culture of the characteristic raised white colonies.
- Identification of yeast-like cells on microscopic examination of a gram stain.
- Abundant growth must be present to be diagnostically significant.
- It is often secondary to prolonged antibiotic therapy.

Prevention

- Careful removal of all food residue from the environment.
- Provide adequate Vitamin A in diet
- Care should be taken to ensure the cleanliness of everything used in handfeeding.
- The infection can be transmitted by secretions of the mouth therefore infected birds, both babies and adults should be isolated from healthy individuals.

- Many breeders use Nystatin suspension in a gavage as a preventive.
- After handfeeding babies should have mouths swabbed with clear water or water to which Vitamin K has been added. This can be followed by a 0.1cc dosage of Nystatin as preventive treatment. This suspension can also be given at the rate of 1 ml per litre of water for 5 days.

Treatment

- Nystatin is the most commonly used drug to treat candidiasis. It comes in suspension or a premix that is added to feed. The suspension seems to be the most effective.
- Other commonly used drugs include Ketoconazole, topical iodine and Nolvasan (Chlorhexidine).
- Selection of the drug of choice depends on the severity of the infection, physical condition of the birds and susceptibility of the particular infection. Yogurt added to handfeed formula in addition to the Nystatin treatment is effective with babies; serving water mixed with yogurt would be used with adults.

TRICHOMONIASIS

Aetiology

- A Protozoan with flagella known as *Trichomonas gallinae*

Signs & Symptoms

- Inflammation, white plaques on the gastrointestinal mucosa, necrosis with accumulation of cheesy material that may occlude the oesophagus and trachea.
- *Young birds*: Crop stasis, poor growth and high mortality. Often infected through parental feedings.
- *Adult birds*: Emaciation, dyspnoea and vomiting are common signs. Usually infected by contaminated food and water.
- A carrier state is possible.

Laboratory Findings

- Identification of trophozoite in warm saline, wet mount prepared from a swab of the oesophagus.
    - These preparations must be examined as soon as they are prepared or the organism may not be recognised.
        - Wright's stain or Trichrome staining is also possible.
        - Cysts do not occur in this organism.
- Diagnosis may be more difficult due to intermittent shedding of the organism. Repeated crop washes may help.

Prevention

- Cleanliness of the environment, food and water is most important.
- Overcrowding may also contribute to infection.

Treatment & Medication

- Advanced cases are difficult to treat and often result in death.
- Imidazole group of medications which can be used, are:
    - Ipronidazole
    - Metronidazole
    - Ronidazole
    - Dimetridazole
    - Carnidazole.

GIARDIA

Aetiology

- A protozoan with flagella. *Giardia psittaci* - commonly found in faeces of asymptomatic adults suggesting an asymptomatic carrier state.

Signs & Symptoms

- Loose, malodorous stools
- mucoid diarrhoea
- debilitation
- gram negative enteritis
- anorexia
- depression
- recurrent yeast infections
- eosinophilia and hypoproteinaemia
- dry skin and feather picking
- can cause poor growth and high mortality in neonates.

Laboratory Findings

- There are two stages in the life cycle of Giardia: the trophozoite and the cyst. Both can be identified in faecal smears stained with Carbol fuchsin or iodine or by flotation techniques with zinc sulfate. These preparations must be examined within ten minutes of collection or the organism may not be recognised.
- Trichrome staining may also be used.

Prevention

- Keep the aviary as clean and dry as possible. This will reduce the viability and number of cysts.
- Contaminated water supplies may be a source of infection. The cysts survive the standard chlorination of water.

Treatment & Medication

- Ipronidazole
- Dimetridazole
- Ronidazole
- Metronidazole

PACHECO’S DISEASE

Aetiology

- A member of herpes virus family

Signs & Symptoms

- Lethargy is often the only sign of sickness seen before sudden death.
- Some birds show yellowish, watery diarrhoea 10-12 days before death followed by inactivity, anorexia,
- lethargy and ruffled feathers. This phase may only last a few hours.
- Because of the acuteness of Pacheco's many bird owners come home to find their previously healthy bird
- Dead.
- A Carrier state is also possible.

Laboratory Findings

- At necropsy the liver may be enlarged with multifocal or widespread necrosis.
- Eosinophilic intranuclear inclusion bodies are seen in hepatocytes and in the spleen.
- The inclusion bodies in the liver are distinctive and characteristic of the disease and their absence even with characteristic symptoms and lesions do not allow a definite diagnosis to be made.
- The virus can be isolated from frozen liver, kidney, spleen, intestinal or faecal sample by a qualified laboratory.

Prevention

- Isolation of any bird suspected of having or being exposed to Pacheco's.
- Regular cleaning and disinfection of the aviary.

Treatment & Medication

- Acyclovir has been shown to be effective for at least some strains of Pacheco's Disease virus.
- The treatment is by gavage or by powdered acyclovir added to the food and is most effective in reducing morality in flock outbreaks if started before clinical signs develop.
- This treatment may cause considerable nephrotoxicity and should be administered carefully in patients with nephropathies.
- An inactivated Pacheco's Virus vaccine is available in the United States. There have been frequent reports of granulomas and paralysis following the use of this vaccine and is intended for use only in high-risk patients.

NON-INFECTIOUS DISEASES

Behaviour Problems

- Feather Picking
- Screaming

Dietary Problems

- Obesity
- Egg-binding
- Metabolic Bone Disease

Toxicities

- Heavy Metal poisoning

OBESITY

Aetiology

- Overfeeding, particularly high fat foods such as sunflower seeds.

Signs & Symptoms

- Excessive weight
- Lipomas and collection of fat over body

Laboratory Findings

- Fine Needle Aspirate and cytology of mass reveals fat globules and no sign of neoplasia.

Prevention

- A good discussion of captive diets is provided in the supplemental reading: *Feeding Birds: Nutrition and Feeding Strategies; Nutritional Disorders*, by Dr Stacey Gelis in Birds 200, PGF Proceedings 2000..

Treatment & Medication

- Place on a diet
- There is a strong swing towards pelleted diets forming the majority of the diets being fed, particularly in pet birds, although it is now becoming more prevalent in aviculture as well. The current recommendation is 60-80% of the diet being pellets and 20-40% being vegetables and fruit with the small balance made up of other treats.
- For birds that will not eat pellets, provide a good quality **budgie seed mix** or a seed mix containing **Hulled oats and French White Millet or Japanese Millet**, to make up the basic part of the diet. Remember that seeds should be clean, dry, be free of rodent droppings and insects, and stored in airtight containers.
- If you wish you may give your pet parrot a maximum of 3-4 of the Sunflower or similar seeds, as a training treat once a day.

- ***Suggested Major Supplements*** (these are added as a main part of the diet to replace seeds)
  - Dark green, leafy vegetables; spinach or silver beet, endive, Chinese cabbage (bok choy), celery, parsley, thistle, dandelion or native grasses and their seeding heads. In most cases, lettuce is not recommended
  - Broccoli, capsicum, tomato, and sweet corn or corn-on-the-cob. May be fed raw or parboiled.
  - Carrot, peas, beans, pumpkin and sweet potato. May be fed raw or parboiled and can be grated.
  - Sprouted seeds: alfalfa, mung beans, cress etc., or the normal budgie seed mix can be sprouted.
  - Small amounts of fruit: apple, peach, pear, plums, apricot, honeydew melon, rockmelon, mango, paw-paw, grapes, cherries, mandarin, orange, nectarines, figs, raisins, sultanas, currants, strawberries, raspberries, blueberries, kiwi fruit, loquat.
  - **Avoid cabbage, cauliflower, brussel sprouts, rhubarb leaves and avocado as they are toxic.**
- ***Suggested Minor Supplements*** (these are added as only a small part of the diet to add interest for the bird or during the breeding season)
  - Animal protein supplement (give each hen ½-1 tsp daily in the breeding season - July-January): Egg and biscuit mix, boiled or scrambled eggs, plain cake (eg. Madeira cake), small pieces of meat or a chop bone , fresh whole-grain or wholemeal bread.
  - Calcium source: shell grit, cuttlebone or products such as Calcivet® or Calcium Sandoz Syrup®.
  - Flowers and nuts (cones and seed pods) from native trees: *Grevillea*, *Acacia* (wattle), *Callistemon* (bottlebrush), *Banksia* cones, pine cones, *Casuarina* cones, *Hakea* seed pods.
  - Branches from native trees (leave the leaves attached) can be used as perches and birds enjoy chewing the bark. Common ones are: *Hakea*, *Grevillea*, *Acacia* (wattle), *Callistemon* (bottlebrush), *Banksia*, *Eucalyptus* (gum trees), C*asuarina* (She-oaks), *Leptospermum* (Tea-tree) and Illawarra Flame Tree. Most non-native trees should be avoided, two exceptions that may be used are Pine trees and the Jacaranda.

Dieting Your Obese Parrot

You can put your parrot on a diet by changing the seed mix to contain mostly French White Millet or Japanese Millet and add some hulled oats. These seeds can be bought at most produce stores. You can also feed measured amounts of food once or twice a day as well as offering the suggested supplements. Parrots should be dieted slowly over many weeks to prevent problems occurring. The easiest way to begin a diet, is to provide seed for 10-15 minutes morning and night - we are putting them onto meals just as people do, so that they will develop an appetite instead of picking at their food all day. Then for the rest of the day replace the normal feed dish but put green, leafy vegetables or other food mentioned in the supplements above, in the food dish. By using the normal feed dish we are telling the bird that this is really food and it is what we want it to eat as a snack between meals.

At the beginning of the diet, have a weight that you are aiming to achieve. Weigh the bird once a week to monitor the success of your dieting. If the bird is not losing weight, discuss it with one of our veterinarians. We recommend that you visit the hospital each 1-2 weeks during a diet for our vets to discuss the progress and provide any tips or hints to improve your success. Remember that it is just as difficult for your bird to lose weight as it is for you. Some lucky people never have a weight problem, but like many of us, many of our birds struggle with their weight. Exercise can be used as part of the weight loss plan but it must be introduced slowly or the bird can be injured. There have been cases of very obese birds that have had the equivalent of a heart attack during heavy and strenuous exercise, so be very careful and don’t allow them to exercise too much, too early.

FEATHER PICKING IN PARROTS

Feather plucking is common, and often a difficult problem to diagnose and treat. Typically, the bird has normal **head feathers** with feather loss or damage only in areas the bird can reach with its’ beak. Anything from small patches, to the whole body may be affected. It occurs commonly in Sulphur Crested Cockatoos, Galahs and Cockatiels, but any species can be affected. There are many causes of feather plucking, so a thorough investigation may be needed to get an accurate diagnosis. Without an accurate diagnosis, effective treatment is very difficult. Unfortunately, there is no single *“magic cure-all”* for feather plucking birds. Listed below, are some of the causes of feather plucking and possible treatments.

Diseases Causing Feather Picking

1. **Allergies:** recent work has shown that some birds are allergic to certain seeds (oats, sunflower and canary seed), and house dust mites. Some birds respond to 'elimination diets', ie. the only seed permitted was millet seed, and the general diet was improved with the addition of fresh fruit and veg. Central heating has been associated with increased dust and allergies in people and birds, as well.

2. **Mites and Lice:** often blamed but rarely a problem. Generally easily diagnosed and treated.

3. **Intestinal Parasites:** worms and protozoal parasites frequently cause feather plucking, especially in Cockatiels and Budgies. Diagnosis and treatment is usually quick and effective.

4. **Low Humidity:** Tobacco smoke and central heating have been blamed for drying out feathers and causing excessive preening. Regular, light water sprays can be beneficial.

5. **Skin Infections:** infectious dermatitis may cause feather plucking or may be the result of it. Beak and Feather Disease often causes feather loss and feather plucking.

6. **Psittacosis:** although pneumonia and gastroenteritis are the most common symptoms associated with psittacosis, many birds pick their feathers as well. Antibiotics are usually curative.

7. **Malnutrition:** common in parrots on seed-only diets. These lead to vitamin, mineral and protein deficiencies which frequently cause feather plucking. Improving the diet will cure the problem.

8. **Cancer:** is common, especially in Budgies, Galahs and Sulphur Crested Cockatoos. The birds will pick at skin cancers or areas of skin overlying tumours. Severe, self-inflicted wounds can result. Many tumours seen in birds can be successfully operated on.

Psychological Causes of Feather Plucking

When all medical causes of feather plucking have been ruled out, psychological causes are considered.

1. **Boredom:** parrots are very intelligent and get bored easily. This is common cause of severe feather plucking. A change of scenery, people or other birds for company, interesting toys, chewable food (such as fruit and vegetables and non toxic wood) to chew, and TV or radio can all help to stimulate bored birds.

2. **Overcrowding:** leads to stress and aggression. This may cause birds to pluck themselves or other birds. Be very careful when placing a new bird into a cage with an existing bird.

3. **Environmental change:** although birds enjoy stimulation they also need routine. Sudden or constant changes can often lead to stress. Frequent cage movements or new toys may cause this.

4. **Poor wing clipping:** may cause a bird to chew at the feathers and over preen.

5. **Sexual frustration:** many single birds may pick their feathers in the breeding season.

However, *don't* introduce a 'mate' without sound advice as this may actually make the problem worse.

Treatment of Feather Picking

This can be a difficult problem to diagnose its cause and so arrive at a treatment regime. There are many causes of feather picking and you need a full work up to rule out causes other than behavioural. If medical causes are identified, treat them before embarking on behavioural treatments.

You have worked up your case and arrived at your diagnosis that a behavioural problem is the underlying cause of the feather picking. What do you do now? You need to discuss the options with your client and make your assessment of which treatment is likely to meet with some success. In all cases you need to be guarded in your prognosis - clients are often quite disappointed when their bird does not respond and they need to be prepared for all outcome possibilities.

SCREAMING

Screaming is reported as being responsible for more birds being abandoned than any other problem. There is often a fine line between normal vocalisation (calling and squawking) and the level when it should be regarded as a behavioural problem (screaming). This problem arises because suppression of normal vocalisation may cause the bird to become stressed. A normal bird does not squawk constantly[1]. Most birds will vocalise and "sing" at dawn and dusk with short bouts during the day. They rarely vocalise after dark. In many instances the birds are vocalising because they have learnt that it is good technique for gaining attention from their owners - feeding them; coming over to the cage or even negative attention such as: throwing something at them; yelling at them; squirting them with a water pistol.

- As soon as screaming occurs, cover the bird with a dark cloth, turn out the light or place it in a darkened room and close the door[1].
- When the screaming cease, open the door and uncover the bird. Speak to it very softly. Teach it that a soft voice attracts you, not a loud one.
- When you are in another room in the house, call to the bird in a gentle singing voice. Eventually, it will mimic you and call back to you in the same style of voice. If the voice is appropriate then you can answer it. If it is inappropriate - ignore it and keep talking in your singing voice.

EGG-BINDING

Aetiology

- Failure of the egg to pass through the oviduct at a normal rate. This may be physiological or obstructive. Dystocia is more advanced stage of egg-binding and is due to the egg being stuck in the distal oviduct.
- A common problem in finches, canaries, lovebirds, cockatiels and budgerigars.

Signs & Symptoms

- Sudden death
- Abdominal straining
- Often bird is on the floor of the cage
- Bilateral leg paralysis/paresis
- Penguin-like stance – especially budgerigar
- Swollen abdomen profile

Laboratory Findings

- Detect on physical examination, ultrasound or radiographs.

Prevention

- Feed balanced diet and provide access to sunlight
- Provide appropriate nesting box

Treatment & Medication

- Prophylactic antibiotics – Amoxycillin, Enrofloxacin
- Lubricate cloaca with creams such as Hibitane or antibiotic eye ointments
- Calcium supplements
    - Calcium Borogluconate 50-100mg/kg IM.
- Glucose/electrolyte supplementation – 10% body weight spread over 24 hours
- Place in a humidicrib at 25-30°C and 70% humidity
- Simple cases should respond to heat, humidity and Calcium supplement within 1-2 hours. The smaller the bird the more critical they become in a short time. Observe the patient regularly and provide more treatment as required.
- Advanced cases may require aspiration of egg contents to collapse through to laparotomy.

METABOLIC BONE DISEASE

Aetiology

- This has many forms: Rickets, Osteoporosis, Osteomalacia, Nutritional Secondary Hyperparathyroidism (NSH)
- Due to a reduced intake of calcium or Vitamin D3 deficiency.
- Young wild Magpies usually have rickets
- Young parrots usually have Nutritional secondary hyperparathyroidism
- Growing birds have a higher requirement for calcium than other animals – 1.5-2.5 : 1. (Ca:P)

Signs & Symptoms

- Bent long bones, especially humerus and tibiotarsus
- Failure to thrive

Laboratory Findings

- Radiography
    - Rickets – widening and distortion of the growth plates & poorly mineralised skeleton.
    - Pathological fractures – bending fractures, not related to trauma

Prevention

- Provide a balanced diet to parents and growing birds

Treatment & Medication

- Place on a balanced diet
- Surgery is not indicated until bird has strong and stable bones, meanwhile apply splints or place in a sling
- Consider euthanasia in severely affected birds.

HEAVY METAL POISONING

Aetiology

- Ingestion of excessive Zinc or Lead – usually from galvanized wire or dishes.

Signs & Symptoms - **none are specific for heavy metal.**

- Dyspnoea
- Sudden death
- Nervous disease signs
    - Seizures
    - Drooped wings
    - Lethargy & ataxia
    - Star gazing
    - Head pressing
    - Unable to fly
    - Paralysis
    - blindness

- GIT disease signs
    - Bright green droppings (biliverdinuria)
    - Diarrhoea
    - Regurgitation
    - Crop stasis
- Urogenital disease signs
    - Haemoglobinuria
    - Haemorrhage

Laboratory Findings

- Collect heparinised blood.
    - Excessive blood levels of Zinc (> 33 ppm suspicious, >75 ppm diagnostic) Remember Zinc is an essential nutrient.
    - Lead >20mcg/dl (0.2ppm) suspicious, >50 mcg/dl (0.5ppm) diagnostic.
- Non-regenerative anaemia
- Elevated LDH, AST, CK and UA

Prevention

- Remove sources of Zinc and Lead from the environment.

Treatment & Medication

- Stabilise the patient with heat, humidity and fluid therapy
- Anticonvulsants if indicated (Diazepam)
- Cathartics – peanut butter or Metamucil PO.
- Chelation:
    - CaEDTA 35mg/kg IV, IM – sid to bid (5 days son, 5 days off then repeat)
    - BAL (Dimercaprol) 2.5 mg/kg IM q4h x 2 days then bid for 10 days. May be used with CaEDTA

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Chapter 7

Common Ferret Problems

Dr Michael Cannon

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1. SARCOPTIC MANGE

Sarcoptic mange (*sarcoptes scabiei*) infestation of ferrets is *very commonly seen in Australia*. Note that many textbooks with have little mention of sarcoptic mange (maybe only have one paragraph dedicated to this condition).

Sarcoptic mange is sometimes reported by ferret owners as ‘footrot’, especially in those who go ‘ferreting’.

Clinical Signs

- most often associated with lesions of the feet
    - dark brown encrustations of the feet, foot pads & nail beds.
    - In severe cases the nail growth may be affected and the ferret may also have great difficulty walking.
    - The mites are easily seen – in large numbers – do a DEEP skin scraping if you have trouble finding them.
    - Generalised mange may also be seen but is less common.

Treatment of Sarcoptic Mange

1. **Remove the encrustations & kill the mites**
    - Anaesthetise the ferret and bathe all feet with dilute chlorhexidine solution to remove the encrustations
    - Be aggressive with this & pare back to fresh, almost bleeding, pads.
    - Pain relief - carprofen or meloxicam at an equivalent cat dose rate.
2. **Then Selamectin (Revolution) monthly for treatment**
    - alternative parasiticide is ivermectin @ 200-500 ug/kg every 7-14 days
    - Remember the zoonotic potential of this parasite
    - Antibiotics only required if secondary skin infection is present.

2. OTHER ECTOPARASITES

Ear mites (*otodectes cynotis*) are not uncommon in ferrets. Again, selamectin is my treatment agent of choice. Flea infestations are also seen in ferrets. Use cat flea treatments or selamectin.

3. INTESTINAL PARASITES

Intestinal parasitism is rarely a concern in ferrets.

Monitor with yearly faecal examinations.

4. HEARTWORM

Ferrets are prone to heartworm infection.

Clinical signs

- similar to those seen in dogs.
- Antigen blood test kits developed for dogs/cats are useful in diagnosis
- Ferrets tend to have a low worm burden if infested
- Treatment can be difficult.
- Recommend that all ferrets are placed on heartworm prevention from a young age

5. INTESTINAL OBSTRUCTIONS

Ferrets are well known to chew anything and will ingest foreign bodies.

- Obstructions or partial obstructions must be placed high on the list of differential diagnoses with any ferret exhibiting gastrointestinal signs.
- Many of these foreign bodies are easy palpable in a conscious ferret.
- Treatment is laparotomy.

6. DISTEMPER

Ferrets are susceptible to the canine distemper virus (paramyxovirus).

Clinical Signs

- Dermatitis
    - especially around the chin and lips and in the inguinal region.
    - usually develops 7-9 days after infection
- Coughing
- Sneezing
- Ocular & nasal discharges
- Pyrexia (>40C)
- Foot pad hyperkeratosis may also develop
- No treatment is available & mortality is close to 100%.
- Prevention is via vaccination

7. NEOPLASIA

Ferrets are prone to several tumours, most notably insulinomas and lymphomas.

7 a. Insulinomas

- Common in middle to older age ferrets (median age 5)
- Tumour of the pancreatic beta cells
- Causes hypoglycaemia from excessive production of insulin.
- Metastases are uncommon

Clinical signs

- Relate to the hypoglycaemia
- Weakness (especially in the hind limbs - ataxia)
- Incoordination,
- Hypersalivation

- ‘glazed’ look
- collapse
- coma
- Signs are more likely if the ferret has not eaten for some time & will likely disappear if fed

Diagnosis

- Serum blood glucose levels
    - usually below 3.4-3.8mmol/l

Treatment

- There is argument in the literature regarding suitability of surgery The tumours can be very small or undetectable at surgery and diabetes mellitus may occur if too much pancreas is removed.
- Medical management is possible with diazoxide, an insulin inhibiting drug, @ 5-30mg/kg bid orally (preferred) or prednisolone 0.2-2mg/kg orally bid.
- Hypoglycaemic episodes are treated with honey, corn syrup or glucose.

7b. Lymphomas

Lymphomas are also a common tumour of ferrets.

Clinical Signs

- non specific (or even absent)
- weight loss
- Coughing
- Lymph node enlargement
- Lymphomas in young ferrets is often much more aggressive
- Suspect if
    - Total white cell count greater than 10,000
    - Absolute lymphocyte count of 3.5 or more
    - A relative lymphocyte count greater than 60%

Chemotherapy has been tried with some success & there are anecdotal reports of radiation therapy helping. Cure is unlikely.

8. HYPERADRENOCORTICISM

Hyperadrenocorticism is a very prominent ferret condition overseas. It is present, but *not as commonly reported in Australia*.

Clinical Signs

- Bilaterally symmetrical alopecia and vulval swelling in spayed jills.
- The disease in ferrets is different form Cushing's disease in dogs or cats
    - serum cortisol levels are *rarely* elevated
    - oestradiol, androstenedione & 17-hydroxyprogesterone *are* elevated.

Treatment

There are arguments as to whether surgery of medical management is best choice

- Adrenalectomy but can be difficult due to the close association of the right adrenal gland to the vena cava.
- Medical management with Leuprolide acetate (Lupron in USA, Lucrin in Australia) or Suprelorin (Peptech)
    - will only suppress the clinical signs, not cure the disease
- The aetiology of this disease is still not clearly understood. Theories include early desexing, photoperiod (ferrets kept indoors), diet, genetics, or viral factors as possible causes.
- Recent research found a close association with immature desexing and adrenal disease.

9. OESTROGEN TOXICITY

Ferrets are seasonal breeders (increasing day length) and induced ovulators.

- An unmated Jill will not ovulate and will likely remain in oestrus.
- The continued high oestradiol levels can lead to alopecia, bone marrow suppression and, ultimately, death.
- **The best prevention is to spay the female ferret.**
- If the ferret is too sick for surgery hormonal stimulation of ovulation is possible via one or two injections of HCG (100IU/ferret IM) 1-2 weeks apart (Chorulon®).

- The vulval swelling usually regresses within a week or so.
- If the vulval swelling does not decrease then consider presence of an ovarian remnant or adrenal tumour (less likely).
- Medical treatments include suppression/elimination of oestrus with drugs such as proligestone (Covinan®) @ 50mg/kg IM.

10. SCENT GLANDS

Ferrets have paired musk or anal glands lateral to the anus.

- Many owners request their ferrets' "scent glands be removed".
- This procedure is now regarded by most exotic pet veterinarians as unnecessary.
- The musky smell of ferrets is primarily from sebaceous skin glands which are under hormonal control.
- Desexing of the ferret will remove much of the odour and anal gland removal is then not necessary.

11. INFLUENZA

Ferrets are extremely susceptible to various strains of human influenza virus.

Clinical signs

- Sneezing
- Nasal discharge
- Coughing.
- There is usually history of a family member having 'the flu' recently.

Treatment is symptomatic.

Remember to warn clients that their ferret can pass the influenza back to humans!

12. SPLENOMEGALY

Splenomegaly may be detected during abdominal palpation. It is a common finding in ferrets. It may be of little clinical significance and is often found in healthy ferrets.

13. CARDIOMYOPATHY

Dilated cardiomyopathy is relatively common in older ferrets.

Clinical signs

- can be non-specific or
- Dyspnoea
- Lethargy
- Heart murmurs.

Diagnosis

- Similar to any other species with cardiac disease
- Clinical examination
- Imaging: radiographs, ultrasound and ECG examination.

Treatment

As for dogs and cats.

14. DENTAL DISEASE

Ferrets are prone to dental disease.

- As for cats and dogs, encourage owners to feed raw bones such as chicken necks weekly.
- Brushing teeth can be useful if the ferret will comply.

15. HELICOBACTER GASTRITIS

Ferrets can develop gastritis due to *Helicobacter mustelae*, which is related to the human *Helicobacter pylori*.

Clinical signs

- usually seen in young ferrets (less than 20 weeks of age)
- Lethargy
- Anorexia
- Progressive wasting.

Treatment

- ‘triple therapy’, similar to humans and dogs & cats
    - amoxicillin, metronidazole and bismuth.

NOTES:

Chapter 8

Common Rabbit Problems

Dr Michael Cannon

HEAT STRESS

Rabbits are very prone to heat stress.

- They cope extremely well with low temperatures but cannot sweat.
- Consider advising clients to place frozen water bottles in the hutch on hot days.
    - Many rabbits will cuddle up to these to keep cool.

CALICIVIRUS

Calicivirus, or Viral Haemorrhagic Disease (VHD), can result in sudden death with no apparent signs of ill health.

The incubation period is only 3-4 days.

On post mortem examination expect food throughout the gastrointestinal tract, an enlarged liver – often mottled & friable – the virus has a predilection for hepatocytes, and possibly an enlarged spleen and haemorrhages in the lungs.

All rabbits should be vaccinated for calicivirus – annually for adults.

- Rabbits under 14 weeks of age are given 2 injections.
- Localised injection site reactions are not uncommon, due to the oil based vehicle of the Cylap® vaccine.
- Reactions can be minimised by ensuring a fresh needle is placed on the syringe after drawing the vaccine and avoiding intradermal injection (given subcutaneously).
- Warn the client of possible hair loss or reddening of the vaccine site.
- Massage the vaccine site to aid dispersal of the vaccine.
- The vaccine is safe to use in pregnant rabbits.

MYXOMATOSIS

There is no treatment for myxomatosis and the disease is almost invariably fatal.

Clinical Signs

- Pyrexia
- Swollen urogenital orifices, lips, eyes
- Swollen & droopy ears
- signs may develop slowly over a few days to a week or so.
- Euthanasia is the best option.
- Control is by limiting access to the insect vectors – mainly fleas & mosquitoes.

Rabbit-to-rabbit transmission is possible. This is most likely when the rabbit has the ‘pneumonic’ form – usually seen as a rabbit with mucopurulent nasal & ocular discharge. Transmission is via aerosol. Direct contact transmission is also possible.

UTERINE ADENOCARCINOMAS IN RABBITS

Prevention is the key to management of this disease in rabbits.

Up to 80% of female rabbits will develop Uterine cancer of not desexed

SPAY RABBITS!

This is the most common form of cancer of female rabbits and is the end point of a gradual process becoming much more common with increasing age.

- 4% of does had uterine cancer age 2-3 years of age
- 60-80% at 5-6 years.
- It doesn't make any difference whether the doe has had never had a litter or had one or more litters: the incidence is still high.
- Spaying a rabbit confers multiple benefits
    - preventing uterine cancer,
    - decreasing aggression
    - facilitating housetraining in the indoor rabbit
    - permitting multiple rabbits to be kept together in a more natural social system than solitary confinement.

RABBIT PREVENTATIVE HEALTH SUMMARY

- Diet: Based on fibrous vegetation: Hay & Vegetables
- Calicivirus vaccination annually
- Annual veterinary examination
- Exercise & exposure to sunlight
- Spay & castrate
- Environmental enrichment
- Minimize contact with ectoparasites

FEEDING

The most common cause of gastrointestinal disease in rabbits is poor diet. There are a large variety of rabbit foods available in pet shops and supermarkets, most, if not all of which are inappropriate for pet rabbits.

What to Feed Rabbits

Rabbits have a gastrointestinal system designed to digest large amounts of fibrous material. Wild rabbits eat grass & weeds, some flowers and other plant material, occasionally fruit and also chew on bark & branches. These items are high in fibre, moderate in protein content and low in sugars and fat.

Unfortunately what most pet rabbits are fed is the opposite of the above. Much of the nutritional data of rabbits as previously been based on commercial rabbits fed for the meat industry, and these rabbits are not fed or bred for a long life.

What are the dietary requirements of a pet rabbit? Harcourt-Brown suggests the following food analysis as a starting point:

- Crude Fibre > 18%
- Indigestible Fibre > 12.5%
- Crude Protein: 12-16%
- Fat 1-4%
- Calcium 0.6-1%; Phosphorus 0.4-0.8%; Vitamin A 10,000-18,000 IU/kg; Vitamin D 800-1200 IU/kg; Vitamin E 40-70 mg/kg; Magnesium 0.4%; Zinc 0.5%; Potassium 0.6-0.7%

Rabbits are hindgut fermenters whereby the caecum produces soft, mucous covered ingesta. The mucous covered pellets which are passed are referred to as caecotrophs or ‘first pass’ faeces. These are eaten direct from the anus and digested – this process is called caecotrophy. Note that increased levels of fibre increase caecotrophy and high protein levels reduce it. The second pass hard faeces consist mainly of undigested fibre.

Fibre is required to maintain microflora of the gut and to allow optimal digestion:

- **Digestible (fermentable) fibre** provides a substrate for bacterial fermentation in the caecum. It allows optimal caecal pH and volatile fatty acid production. IT prevents proliferation of pathogenic bacteria in the caecum and increases the fibre content of caecotrophs.
- **Indigestible fibre** passes through the gut without entering the caecum, passing directly to the colon, then expelled as hard faeces. Indigestible fibres are particles with composition greater than 2-5mm. Indigestible fibres plays important roles - in stimulating gut motility, providing dental exercise & tooth wear, stimulates appetite, promotes ingestion of caecotrophs and provides relief from boredom.
- Too little indigestible fibre results in reduced gastrointestinal motility – the main factor in ileus (see discussion below). Too much indigestible fibre results in malnutrition.

Here are some general guides for feeding pet rabbits. The basis can be summarised as the ‘***Hay & Vegies diet’***:

- ***Grass & hay should be available at all times***. They are ideal sources of both digestible & indigestible fibre. The majority of the hay should be grass hay (sometimes called meadow hay) or occasionally Lucerne hay. Lucerne hay should not be fed in large amounts due to its higher calcium content (the exception is young, pregnant or lactating rabbits). Grasses of most (if not all) kinds can be offered
- Most rabbits will eat a variety of ***garden weeds.*** This includes items such as Milk Thistle.
- A **range of vegetables** can be offered. Unless a large amount of a single item is fed for periods at a time, there is very little concern with the types of vegetables offered. Leafy green vegetables and items such as spinach leaves. Bok choy, broccoli, herbs, sprouts, carrots (with tops) and lettuce mixes should be the mainstay of the vegetables offered.

- **Fruits** are offered occasionally or as a treat. Many are low in fibre.
- ***Feed limited quantities, if any, pelleted food***. The concern with pelleted diets are many: they provide little dental exercise; are not a good source of indigestible fibre; are often lacking in vitamin D or calcium; can have sweetening agents added; many are high in carbohydrates and/or fats. Pelleted diets are usually offered ad libitum and the result is obese rabbits. If you must recommend pelleted food do not offer more than 3% of the rabbit's body weight daily (from Harcourt-Brown).
- Rabbit mixes have many of the problems associated with pelleted foods. In addition, they often contain large amounts of legumes, cereals and/or nuts – even chicken pellets may be present! Selective feeding of these rations usually occurs commonly leaving the diet deficient in fibre and calcium. **Avoid rabbit mixes completely**.
- No salt licks or supplements are required.

SUMMARY

Hay

- Do choose hay carefully - hay fed to horses is usually good quality and can be obtained cheaply from feed stores.
- Don't feed hay that is dusty, or smells musty. Good hay smells sweet and is sometimes slightly green.
- Do store hay where air can circulate - not in plastic bags.
- Do try different hay for your bunny - some prefer soft grass hay, others seed hay which has a harder texture and often longer strands. Bagged hay sold in pet shops is often very poor quality and deficient in important nutrients - it's no wonder so many rabbits refuse to eat it!
- Don't feed too much Lucerne (alfalfa) hay if your bunny is overweight. The calcium content is too high for adult rabbits. It can be fed in larger quantities for juvenile rabbits.
- Do try straw or kiln-dried grass either in addition to hay for variety, or instead of hay if your bun is a fussy eater.
- Do put hay in the litter tray - rabbits like to munch when pooping!

Understanding Rabbit Food Labels

Rabbit/Guinea Pig Mix (also called coarse mix) - Muesli-type mix of various ingredients. Popular with owners and some rabbits; wide selection available; possibly better chewing exercise for the rabbit than pellets, but this is not an issue if you're also feeding hay as you should be. If the rabbit only eats its favourite bits then selective eating becomes a problem and dietary imbalances can occur. This will also be an issue if you have two rabbits living together and each eats different components.

Rabbit Pellets - Some rabbit owners complain that pellets look "boring" - which is a silly reason for rejecting a potentially good feeding option - after all, grass looks pretty boring to us but it's the best food for rabbits! Bunnies that are used to eating mix tend to turn their noses up at pellets, but they do eliminate the problems of selective feeding.

Extruded foods - All the advantages of pellets but with much greater palatability. Tends to increase water consumption. These foods are increasingly popular and available in most supermarkets and feed stores in Australia. Ensure they have high fibre, moderate protein & low fat – read the label! Example – Lovitt’s rabbit food.

Understanding the Bacteria in the Rabbit Gut

The rabbit intestinal tract is teeming with bugs - the entire functioning of their digestive system relies on a healthy population ("flora") of beneficial bacteria in the hindgut. If the delicate bacterial population becomes unbalanced, and ‘bad bugs’ multiply out of control, serious or even fatal diarrhoea can occur. This can occur if the rabbit is stressed or otherwise unwell; after some antibiotics; or especially after changes in the diet.

This is why you should never change your rabbit's diet suddenly - the bacteria need time to adapt to different foods. Take at least a week to switch between different brands of mix/pellets. Constant access to hay cushions dietary changes, but the fatal intestinal upsets commonly seen in bunnies purchased from pet shops are a grim reminder of the importance of going slowly when changing foods. Baby rabbits just can't handle sudden changes in diet just as their gut bacterial population is becoming established after weaning; and pet shop bunnies often undergo two changes of diet in quick succession.

Supplements & Sunshine

Cast your eye along the shelves of the pet shop and you'll find selection of mineral licks and vitamin supplements. Many of you will be aware that calcium deficiency has been linked to dental disease in rabbits: it's not surprising that rabbit owners often give vitamin and mineral supplements to their rabbits not realising they could lead to more problems than they solve.

Rabbits do not routinely need a supplement. In fact, if a bunny is given extra calcium or vitamin D it doesn't need, it may run into problems with urinary stones, as it has to excrete the excess via the urinary tract. There is a place for vitamin/mineral supplements in bunnies who are selective eaters or who have established dental disease with poor bone quality. In these circumstances follow your vet's advice.

But what about sunshine? A paper in the Veterinary Record in England a few years ago by vet Frances Harcourt Brown showed that rabbits living loose outside had far higher levels of vitamin D than those living in hutches. What are the implications for house rabbits?

Rabbits, like people, obtain vitamin D (which enables the body to utilise dietary calcium) either from their diet or after exposure to sunshine. Full-time house rabbits, and rabbits confined to hutches don't have any opportunity to manufacture vitamin D from sunlight and must obtain all the vitamin D they need from their food.

This won't be a problem if your bunny is eating a sensible diet as described above - there's no evidence that a healthy bunny eating a decent diet is deficient in any vitamins or minerals at all. But if an indoor bunny is also a selective eater then you may run into problems. If you have such a rabbit and can't persuade him to eat a better diet then regular exercise outdoors in natural light will do much more for his physical and mental health than plugging the dietary gaps with a vitamin supplement, but you should talk to your vet for dietary advice.

Diet & Dental Health

Diet plays a crucial role in rabbit dental health. Most pet rabbits have some degree of dental disease, and most eat a poor diet. Bunnies who are selective eaters, refusing to eat the supplemented parts of a coarse mix, are often calcium deficient. But beyond that there's some controversy as to exactly what is going on.

One theory is that calcium deficiency is the primary problem - wild rabbits aren't calcium deficient, and have lovely skulls and teeth. The other is that wild rabbits have healthy teeth because their diet is based on grass, so their teeth wear down correctly and normal mechanical function is maintained in the back teeth. In fact, the two theories are not mutually exclusive: a calcium deficient rabbit will have poor bone quality, enabling the roots to push backwards into the jaw more easily once the jaw mechanics have gone wrong. Whichever theory you subscribe to, the conclusion is the same - a balanced, hay-based diet will tackle the problem.

This information above is based on work done by Dr Brendan Carmel, an Exotic Pet veterinarian in Melbourne.

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Chapter 9

Common Reptile Problems

Dr Michael Cannon

The important take home message is that in reptiles, infectious diseases are often secondary to Husbandry Problems as discussed in the earlier lecture.

1. HYPOTHERMIA

- Condition seen mainly in captive lizards and snakes
- Reptiles choose the coolest part of the vivarium (and not the warmest) and stay there, unable to thermoregulate
- Shutdown due to environmental cause not disease
- History of (dis)stress or poorly furnished enclosures
- This is caused by
- a failure of the heating supply to the cage
- Some handlers place a reptile in a refrigerator or freezer to facilitate handling.

Signs

- Respiratory Disease – blowing bubbles from the nares.
- Ocular and nasal discharges
- Colic, due to fermentation of food because the digestive enzymes do not function well at low temperatures.
- Necrosis of digits and terminal appendages due to frostbite

Treatment

- Over a 2-4 hour period, slowly heat the reptile to its PBT
- Maintain observations for up to 10 days.
- Treat any problems as they arise.
- Respiratory problems
- Begin an appropriate antibiotic.

Prevention

Use a Thermometer and/or Hygrometer to monitor the temperature and humidity being provide din different areas of the enclosure

2. ECDYSIS (SHEDDING OF THE SKIN)

- Snakes shed their skin in one piece, including the spectacles.
- Lizards and turtles shed their skin in pieces.
- Skin of a snake will become cloudy in appearance and the spectacles assume a blue colour just prior to ecdysis.
- Dry or unhygienic conditions may lead to dysecdysis in captive snakes.

3. STOMATITIS (CANKER)

Most common in captive pythons

- but occurs in all orders of the class Reptilia

Signs

- Anorexia
- Drooling
- Swelling
- bleeding gums
- abscess

Look for the initiating cause - Related to Husbandry

- poor hygiene
- hypothermia
- poor water quality (Chelonia)

Treatment

Correct the underlying husbandry problem and treat other signs symptomatically – rehydrate and antibiotics for secondary mouth infections (Tazocin, Fortum).

4. EXTERNAL PARASITES

4.1 Mites

- *Ophionyssus natricis* – has a short life cycle
- Common in snakes and lizards

Signs

- Trouble shedding (dysecdysis)
- Snakes spend long periods soaking in water
- Related to poor hygiene and quarantine practices

4.2 Ticks

5. INTERNAL PARASITES

- Roundworms
  - Ascarids – Ophidascaris moreliae, Polydelphis anoura
  - most common in snakes
  - Strongyloides – direct life cycle- snakes and lizards
- Tapeworms
- *Protocephalidea, Pseudophyllidea,*
- *Sparganosis* - Spirometra and Diphyllobothrium
- Pentastomids – respiratory system and tongue worm - zoonosis
- *Rhabdias spp* – lungworm direct life cycle

Species

- Snakes
  - Roundworms - swellings, abscess, gastrointestinal obstruction
  - Occasional tapeworm infestation
- Bearded dragons
  - nematodes in throat and bowel (pinworms)
- Elapids
  - pentastomids – lungs, trachea

6. SKIN INFECTIONS

- Blister disease (ventral necrotic dermatitis)
- Pythons
    - Caused by excess humidity, poor hygiene, unsuitable substrate, hypothermia
    - Early stages – blistered single scales
    - Later stages- patchy to generalised sloughing and smelly and greasy skin
- Address husbandry issues
- Antibiotics (Gram stain, cytology)

7. WELFARE ISSUES

- Live feeding
    - Rat bite wounds
    - Frozen prey items
- Rostral abrasions
- Eastern water dragons and MBD
- Hygiene, disinfection and quarantine

8. METABOLIC BONE DISEASE

Eastern water dragons (*Physignathus leseuri*) are very prone to MBD

History

- Limited or no access to UVB and natural sunlight
- Young lizards, especially Eastern Water Dragons and Bearded Dragons
- Diet – low calcium, low vitamin D_3

Signs

- Muscle tone, posture, twitching
- Misdiagnosed as neurological disease
- Mouth – rubbery jaw
- Skeletal deformity
- Early stages - twitching, muscle tremors, fitting
- Later stages – anorexia, muscle weakness, paralysis, rubbery jaw, death

Diagnosis

- radiography
  - demineralised skeleton
  - pathological fractures

9. RESPIRATORY DISEASE

- Occurs in all orders of the class Reptilia
- Pythons – upper respiratory stridor, mouth breathing, anorexia
- Turtles – anorexia, conjunctivitis, rhinitis, mouth ulcers, floating abnormally
- Lizards – sneezing, conjunctivitis, blepharitis
- Related to poor hygiene, hypothermia

10. OBESITY

- Certain species are prone to obesity
- *Aspidites spp* (black headed python and woma)
- naturally reptile eaters
- captive diet is too fatty
- Hepatic lipidosis (fatty liver) may occur
- neurological signs in an otherwise healthy looking snake
- Food quantities and frequency of feeding should be adjusted
- Bearded dragons (*P. vitticeps* and *P. henrylawsonii*) are also prone to obesity

11. TRAUMA

11.1 Limb Fractures

Signs

- Lameness
- Limb deformity or angulation
- Usually closed injury due to tough skin
- Detect with radiography
- This may be trauma from cagemate fights, falls etc.
- Predisposed by Metabolic Bone Disease.

Treatment

- Long bone fractures often require surgery.
- In very small patients, use of light splints and tape such as Micropore is recommended.
- During fracture repair
    - maintain the animal in a small enclosure with no climbing material
    - Use radiology to follow callus formation
    - Once the callus has formed, you may need to use physiotherapy to restore normal limb function.
    - Return to full use may be as long as 18 months.

11.2 Shell Fracture

- Any injury needs to be cleaned and assessed
- Remove any debris that is in the wound
- Use radiology to assess the extent of internal damage
- Check for any other fractures in the limbs
- Debridement and lavage under anaesthesia.
- Use antibiotics for at least 1 week

Shell Fracture Repair

- Fractures
    - Wiring with cerclage wire
    - K-wire to drill the small holes and to elevate any fragments into correct apposition
    - wire is left in place until radiography displays a union has occurred.
- Repair damaged shell:

*AAVAC AVA Conference Proceedings 2004: Shell Fracture Repair Using Glass Ionomer Cement in the Long-neck Turtle (*Chelodina longicollis*)*

Anne Fowler BVSc & Nick Magelakis BDS

Dental Product - Glass Ionomer Cement

11.3 Bites from Prey

Signs

- Maceration of skin surface, with exudation.
- Ulcers as deep as the muscular layer.

Prevention

- DO NOT feed live rodents to carnivorous reptiles - unless you stay and observe

Treatment

- Anaesthetise or sedate the reptile
- Flush all wounds with saline
- Debride all necrotic or avascular tissue
- Do not try to close skin deficits with tension on the skin – these usually break down
- Apply a dressing to cover all but minor wounds
- DuoDerm to cover the wounds
- Dermaclens or Silvazene

- Change bandages each 2 days
- Place in a clean cage, take care that the substrate does not become lodged in the wounds
- Topical or systemic antibiotics if indicated.
- Healing by granulation is much slower in reptiles than mammals
- Scars that form may be a problem with ecdysis in the future.

11.4 Rostral Abrasion

Signs

- Abrasion of the epidermis and soft tissue structures of the lips and nasal plane
- Maceration of skin surface, with exudation.
- Ulcers
- Infection of exposed tissue and may lead to necrotic stomatitis

Causes

- Animal rubbing its rostrum on the cage walls in an attempt to escape
- Common in newly acquired animals or ones that have become stressed.
- Associated with overcrowding
- Seen in lizards, snakes and crocodilians.

Treatment

- Clean the damaged tissue
    - povidone-iodine or chlorhexidine solution
    - Apply a topical antibiotic ointment
    - Balance the benefit of treatment against the level of stress being generated in the patient.
- Improve the environment
    - visual barriers - reduce escape routes, provide privacy
    - Provide a hide box or similar to improve the sense of security.
    - Remove abrasive materials in the enclosure.

12. SWELLINGS

12.1 Head and Eyes

- Mites
    - Periocular
    - heat sensing pits
    - Midline submandibular fold
- Retained spectacle
- Subspectacular abscess
- Abscess

Lizards

- Abdominal swelling
    - Tumours, eggs, foreign bodies, impacted stomach

12.2 Cloaca

- Cloacal infection is common post mating
- Swelling, inflammation and crusty discharge
- Abscessation of the gland or hemipene sulcus

13. HYPERTHERMIA AND THERMAL BURNS

Signs

- Hyperthermia – collapsed, depressed or comatose. May be found dead.
- Burns or charring on skin. There may be areas of blistering and/or ulcers.
- Secondary infection may occur in older wounds.
- Dehydration

Causes

- Inappropriate heat source
    - naked light bulb that a snake can coil around
    - Lamps too close to the substrate
    - Inappropriate thermostat on heating pads etc.
    - cage left unattended in strong sunlight
    - reptiles that emerge after a bushfire.
- Reptiles will remain in the heated position
    - make no effort to move away
    - rely on positional changes to lose heat
    - most of their strategies are geared towards gaining heat.

Treatment

- Hyperthermia
    - place in a cool bath.
    - Provide cool fluids orally or as a bath.
- Burns
    - parenteral fluid therapy to combat the fluid loss
    - intraosseously or subcutaneously- 20-40 ml/kg/day.
    - Clean the lesions with povidone-iodine or chlorhexidine
    - Apply Silvazene Cream and/or an antibiotic ointment.
    - Cover wounds with Opsite or DuoDerm dressings. Bandages should be changed each 2 days. Surgical debridement may be necessary.
    - Use appropriate antibiotic injections
    - Healing of burns is much slower in reptiles
    - Check all thermostats, provide a proper thermal gradient. Check the animal's Preferred body Temperature (PBT) is being met.

14. REPRODUCTIVE

Pythons

- Cooling is required for oogenesis and spermatogenesis.
- Cooling down in captivity, may lead to post hibernation anorexia.
- Gravid or ovulating female pythons usually do not eat.
- Diamond/carpet pythons – lay 20-30 eggs.

Lizards

- Male lizards have 2 hemipenes
- Skinks are difficult to sex – some operators can evert the hemipene with patience and pressure
- Bearded dragons
- Male: hemipene bulges either side of tail base; Larger head, dominant behaviour
- Female: central bulge
- Eastern water dragons
- Male: femoral pores, hemipene bulges
- Monitors
    - - Radiography is necessary
    - - Ossified bodies in hemipene sulcus

      Present = male

      Absent = female or juvenile male
- Technique may be used for all species of varanids

Snakes

- Male snakes have 2 hemipenes
- Tail shape
    - Male – thicker at base
    - Female – slender
- Spurs – vestigial hindlimbs – larger in the male
- Probing of the hemipene sulcus caudal vent
    - Male – 10-12 subcaudal scales in depth
    - Female – 4 subcaudal scales

14.1 Dystocia

- Pythons and chelonia are more prone to dystocia
- Turtles
    - History of disease or injury
    - Lack of substrate for oviposition
- Pythons
    - Suboptimal vivarium temperature
    - Obesity, poor physical condition, lack of muscle tone
    - No nesting site
- Dystocia also occurs in lizards – follicular stasis

Signs

- Prolonged gestation is difficult to estimate

There is a large variability due to environmental factors

- Partial delivery of eggs/young.

Can still palpate them in coelomic cavity

- Distended cloaca and straining +/- nest building but no progress
- Egg binding in chelonians can present as anorexia, depression +/- hindlimb paresis

Diagnosis

- Palpate the coelomic cavity
    - chelonians, hold them in a vertical position and insert your fingers anterior to the hindlimb.
- Radiography and ultrasonography

Treatment

Lubricants

- per cloaca
- gentle external massage
- Flush the oviduct with warm saline when the procedure is complete

Medical

- 10% calcium Borogluconate (0.5cc/kg)
- Isotonic fluids (2% of body weight) SC
- Oxytocin (1.0-10 IU/kg IM)

  higher dose seems more effective

- Arginine Vasotocin (0.1-1.0 mcg.kg IM)

  Vasotocin is more difficult to obtain and is unstable once reconstituted, it is stable for 6 weeks if frozen or 5 days if chilled.

- Place the animal in a warm bathe for 2-3 hours then in a humid enclosure at their PBT.

Surgery

- Coeliotomy
- Oviduct is friable
- Egg/foetus may be adhered to the wall
- Incison over each site to remove the egg/foetus.
- Close with an inverting absorbable material (4/0 to 6/0 Dexon, Maxon or PDS)
- It is safe to leave the area unsutured.

14.2 Prolapsed Cloaca, Oviduct or Hemipene

Signs

- Males: one or both hemipenes prolapsed
- Often swollen and traumatised, covered in exudate and debris
- Female: usually a partial oviduct exposed.

Treatment

Mild case:

- clean tissues
    - povidone-iodine or chlorhexidine solution
- Apply an antibiotic ointment.
- Glycerine or 10-50% Dextrose solution
    - reducing swelling.
- Gently replace the tissue with a cotton bud
- Episiotomy to allow full reduction.
- A purse-string suture
    - Allow enough opening to excrete faeces and urates.

Severe case:

- Amputation may be required
- through and through mattress sutures at the base of the prolapse
- stump should reflect back into the cloaca.
    - There is no need to be concerned regarding damage to the urethra
    - Males breed successfully with single hemipene.
    - In females - a salpingectomy. Do not attempt to remove the ovary, may cause fatal haemorrhage.

15. NEOPLASIA

Signs

- Swelling
- Many tumours have been reported.
- Often this is seen as an intracoelomic mass

Diagnosis

- Perform a biopsy and histopathology if possible.
- Cytology (fine needle aspirate) may also be helpful.
- Granulomas may mimic a tumour.

16. CIRCULATORY SHOCK

Signs

- Lethargy, coma
- Pale Mucous membranes
- Cold extremities
- Low RR and HR

Treatment

- Fluid therapy
- Raise the environmental temperature,
- intubate and give oxygen by IPPV if possible

17. HYPOGLYCAEMIA

Signs

- Swimming in circles
- Mydriasis
- Muscle tremors
- Opisthotonus

18. GOUT

- Associated with a renal disease
- Uric acid
    - levels in the blood exceed the renal threshold
    - Uric acid crystals are deposited in the joints and on organs
- Dehydration, high protein intake in diet and kidney failure or renal toxins are common causes.
- Prognosis is always guarded.

Signs

- Visceral Gout
    - Lethargy
    - Dehydration
    - Anorexia
    - Occasionally seizures and incoordination
    - Sudden death
- Articular Gout
    - Swollen joints
    - Lameness
    - Lethargy
    - Dehydration

Diagnosis

- Radiography to assess joints
- Aspirate synovial fluid. Examine microscopically for urate crystals
- Blood Uric Acid fasting levels

snake = 2-5 mg/dl = 0.12-0.30 mmol/L

crocodile = 11-4 mg/dl = 0.06-0.24 mmol/L

NB the uric acid level may normally increase 5-10 times within 4 days of a meal

Treatment

- Fluid therapy
- Allopurinol (20mg/kg sid for at least 3 weeks)
- Decrease protein intake.
- Articular gout – increase ambient temperature and restrict movement.
- Surgery on joints is contra-indicated.

SUMMARY

- Physical examination and diagnosis in reptiles is challenging
- Basic principles from mammalian practice are easily adapted to the class Reptilia
- A thorough knowledge of the NORMAL is essential in understanding the ABNORMAL
- Veterinarians and reptile keepers must be aware of the importance of proper and acceptable husbandry techniques
- Always HEAT up a sick reptile
- Never COOL down a sick reptile

NOTES:

Chapter 10

Common Rodent Problems

Dr Michael Cannon

COMMON DISEASES IN MICE AND RATS

1. MAMMARY TUMOURS

Mammary Tumours

Mice: **usually malignant – adenocarcinoma or carcinoma.**
Fibrosarcomas are also possible.

Rats: **usually benign – usually fibroadenoma.**
Adenocarcinoma present in <10% cases in rates.

These are the most commonly encountered neoplasia in rats & mice. Mammary tissue has an extensive distribution in subcutaneous space in rats and mice, so a tumour may occur in nearly any location. Any subcutaneous mass is considered to be a mammary mass until proven otherwise.

Because of the nature of the form of mammary tumour encountered in each species, surgery is commonly preformed in rats but rarely in mice.

Mammary masses in mice are often associated with mammary tumour viruses. These masses are often quite aggressive in their behaviour and grow rapidly.

There is still debate as to the preventative value of early desexing of rats and mice for mammary masses.

2. OBESITY

Obesity is a common problem in pet rats & mice.

The most common cause is overfeeding commercial rat & mice pellets, particularly if they are provided ad lib.

Treatment:

- Weigh regularly
- Restrict access to commercial pellets

3. CHRONIC RESPIRATORY DISEASE

Chronic disease of the upper and/or lower respiratory tract is endemic in most rat and mouse colonies.

Clinical signs

- dyspnoea - many display with abdominal breathing
- nasal discharge
- sneezing
- sniffling
- respiratory ‘clicking’ sounds.

The cause is regarded as multifactorial - combination of two or more components of viral, mixed bacterial (*Streptococcus spp*, *Bordetella bronchiseptica*, *Pasteurella multocida*,*Corynebacterium kutscheri*, *Chlamydia spp*) or *Mycoplasma pulmonis* organisms as well as stress.

Most common cause: Sendai virus in mice; cilia-associated respiratory (CAR) bacillus in rats.

Treatment

In most cases a cure is unlikely so focus is on control of clinical signs.

- Rats
  - Enrofloxacin (Baytril) 10mg/kg sid or bid + Doxycycline (Vibravet paste) at 5mg/kg sid or bid.
  - Treatment is usually daily and lifelong with severe cases.
  - Some rats stabilise for months before developing a severe bronchopneumonia leading to death. Some authors have had success with tetracyclines (3mg/lg in water) for control respiratory disease in mice. Mucolytics are sometimes recommended.

Dosing a juvenile rat with Doxycycline can cause yellowing of the teeth, similar to that seen in other mammals but this is usually ignored as there is a physiologically normal yellowing of the teeth caused by iron deposits in the tooth enamel, as the animal ages.

3a. Sendai Virus

- Common in laboratory rodent colonies
- Most commonly seen in suckling and weanling mice

Clinical Signs

- Adult mice rarely show symptoms
- Dyspnoea and laboured breathing
- Chattering
- Harsh/rough hair coat
- weight loss
- sudden death.
- Secondary bacterial infections can complicate this viral disease

Treatment

- No specific treatment
- Supportive care
- Treat secondary bacterial infections

4. OVERGROWN TEETH OR MALOCCLUSIONS

Many pet rodents develop overgrown incisor s due to inappropriate feeding practices.

Clinical Signs

- Slobbering (saliva stain around mouth, lips and chin
- Anorexia or inappetance
- Poor growth

Treatment

- Regular reduction of incisor length (4-5 week intervals)
  - Use a high speed drill or Dremel tool – be careful to not overheat the tooth and damage the pulp
  - Some people use dog & cat nail clippers
    - These can cause longitudinal shattering and expose the pulp to infection
  - In severe cases, extraction of the incisors is an option that may be considered.

5. CHRONIC RENAL DISEASE IN RATS

Chronic progressive renal disease (nephrosis/nephropathy, Chronic Progressive Nephrosis - CPN) is a significant disease in aged rats. Lesions include glomerulosclerosis and interstitial fibrosis. Usually in rats over 1 year old. It is more common in male rats.

Clinical signs

- Polyuria/Polydipsia
- Marked proteinuria (>10mg/l). Protein losing nephropathy.
    - +/- isosthenuria and azotaemia.
- Kidneys may be enlarged and cystic.

Treatment

- Can be difficult
- Reduced caloric intake
- reduced protein diet – offer soybean protein sources
- supportive care
    - ACE inhibitors and diuretics
    - Omega-3 fatty acid supplements
    - Anabolic steroids
    - B complex vitamin supplements
    - Phosphate binders
- this disease is usually progressive, and inevitably fatal once diagnosed

6. ECTOPARASITES

There are several species of mites found in the fur of rats & mice.

Mice

- *Myobia musculi*
- *Radfordia affinis*
- *Myocoptes musculinus*

Rats

- *Radfordia ensifera*

Clinical signs

- Pruritis
- alopecia or thinning of hair
- excess scurf
- self induced trauma.
    - ulceration over dorsum and shoulders
    - facial excoriation
    - severe pinna trauma

Diagnosis is similar to ectoparasites in cats & dogs:

- Microscopic examination of:
    - Plucked fur sample & Trichogram
    - Sticky-tape preparation
    - Skin scraping – both superficial and deep

Treatment

- Ivermectin
    - Topical, oral or injectable each 2 weeks
    - Dose is 200-500 ug/kg.
- Selamectin (Revolution) topically dorsal cervical area 10mg/kg
    - Treat all in-contact animals
    - Appears to have a wide safety margin
    - Apply a small drop of the kitten/puppy preparation or dispense into 1ml syringe & dose appropriately.
- Clean out enclosure and substrate
- Secondary bacterial infections with *Staph Aureus*.
    - Chlorhexidine wash (Pyohex®, Dermcare)

    - Miconazole + Chlorhexidine wash (Malaseb®, Dermcare)
    - Wipe these onto the appropriate area rather than immerse the patient in a bath
- Pain control of acute trauma
    - Meloxicam (Metacam Oral, Boehringer Engelheim) 0.1-0.2mg/kg PO or SC sid.

7. ENDOPARASITES

The common endoparasites found in rats and mice are usually not pathogenic, unless they are present in unusually large numbers

For monitoring, it is recommended to perform a faecal flotation on fresh faeces each 6-12 months. Removal of all endoparasites from a colony can be difficult so using strategic worming and monitoring with an aim to maintain the parasites at a low level is often recommended.

Treatment

- ***Pinworms and other nematodes***: Ivermectin or moxidectin
- ***Tapeworms***: Praziquantel.

8. BARBERING

This is a behavioural problem where the dominant animals chew the whiskers and fur of the less dominant animals. It can be confused with ectoparasite infestation, so always perform tests to rule these out. Observation of the group will often reveal the problem.

Treatment

- Isolate individuals with significant fur loss.

9. RED TEARS/CHROMODACRYORRHOEA

This presents as red discharge or stain from the nose or eyes. Many clients think that the rodent has bleeding from its eyes or nose.

It is commonly seen in rodents that are under stress, so observation is required to identify potential stressors.

The red stain is due to porphyrin secretions from bacteria that proliferate when there is excessive discharge from the harderian glands of the eye – similar to that seen in white poodles and their excessive ocular discharge.

10. DIARRHOEA

Many rats and mice will develop enteritis that leads to diarrhoea. The underlying causes for this are many and varied. Approach as you would for a cat or dog.

Diagnosis

- faecal flotation
- faecal smear
- Swab for culture & sensitivity

Treatment

- Supportive care
- Identify and eliminate stressors
- quarantine

11. TYZZER'S DISEASE IN RODENTS

This is a common problem in caused by *Clostridium piliformis* (previously *Bacillus piliformis*). This can cause high death rates in juvenile rodents that are stressed, especially mice.

Clinical signs

- usually non-specific
    - ruffled fur
    - lethargy
    - hunched posture
    - poor appetite.
- Diarrhoea may be present.

Necropsy

- changes to the heart, liver lymph nodes and digestive tract

Prevention

- Attention to high level of hygiene and sanitation is paramount
- Minimise any stressors
- Most commonly seen in rodents stressed by
    - Shipping
    - Weaning
    - Environmental changes
- Maintain strict quarantine with introduction of new animals
- Normal looking animals can be asymptomatic carriers.

12. SIALODACRYOADENITIS IN RATS

This is usually a self-limiting disease (usually 1 week) of young rats and recently weaned mice.

This is caused by a virus spread by aerosol from respiratory discharges

Clinical Signs

- Vary with the age and immunocompetence of the affected rat or mouse.
- most serious in 2- 4 week old rats with no maternal antibody protection.
- ***Initial signs***
    - Squinting
    - Blinking
    - rubbing of the eyes.
- ***Later signs***
    - Sneezing
    - Swelling of the cervical area
    - Swellings ventral ocular or periorbital area.
    - eyes bulging
    - red-brown tears
    - self-trauma to the eyes
    - Respiratory signs may be present, especially if complicated by Sendai virus or murine mycoplasmosis.

13. PODODERMATITIS

This is more common in rats than mice. It is usually associated with inappropriate substrates such as wire flooring. It is more common in overweight or aged animals.

Clinical Signs

- Erythema of feet
- Swelling and ulceration of plantar and palmar aspects of feet

Treatment

- Address underlying causes such as obesity
- Apply diluted chlorhexidine wash by dabbing onto area
- Some animals will tolerate Silvazine Cream (Smith & Nephew) or Muporicin (Bactroban, GlaxoSmithKline Australia)
- Meloxicam orally 1mg/kg Po sid.
- Severe cases may require systemic antibiotics

14. HEAD TILT

This may be associated with vestibular disease. Rats and mice can develop peripheral vestibular disease from infection with *Mycoplasma pulmonis*.

Clinical Signs

- Circling in direction of head tilt
- Signs of respiratory disease may also be present

Treatment

- Antibiotics may not eliminate head tilt but are useful to remove the Mycoplasma
  - Enrofloxacin (Baytril, Bayer) 10mg/kg SC bid + Doxycycline (Vibravet, Pfizer) 5mg/kg PO bid.
  - Nebuliser to deliver medications
    - Enrofloxacin (Baytril, Bayer)
    - Hypertonic saline
    - F10 disinfectant diluted 1:250
    - Acetylcysteine
  - Bronchodilators
    - Theophylline (Brondecon Elixir, Pfizer) 5-10mg/kg PO bid
    - Salbutamol – use puffer to fill a small container bird is in.
  - Nutritional support.
    - Smear Nutrigel (Ilium) onto mouth and lips
    - Use food blender to liquefy foods to make easier to ingest
      - Mix Commercial pellets + fresh vegetables with enough water or electrolyte solution to form a liquid slurry

ANAESTHESIA IN MICE & RATS

The literature contains many different anaesthetic regimes for rats & mice.

I have listed below a summary of important factors to consider and my personal anaesthetic regime (not everyone will agree that it is the best approach, however it works well for me):

- I do not routinely fast prior to anaesthesia as rodents have difficulty vomiting so it is not an important risk factor as with cats and dogs. In many cases they have food removed 2-3 hours prior to anaesthesia so there is no food particles present in the oral cavity.
- There is a large range of recommended premedication agents.
  - I prefer Midazolam (1-2mg/kg IM).+ Butorphanol (1-2mg/kg SC).
  - Another successful combination is Acepromazine (1-2mg/kg) + Buprenorphine (0.05-1mg/kg)
- Induction with isoflurane via mask
  - Consider pre-oxygenation for several minutes.
  - Maintain on 1.5-3.5%.
- Control heat loss.
  - Use heat pads, bubble-wrap or heated air.
  - Minimise clipping or overuse of skin disinfectants.
- Monitor
  - RR & HR.
  - If possible, use a Doppler for heart rate & rhythm.
- I prefer to avoid injectable anaesthetics. Many authors recommend their use.
- Use careful surgical technique to minimise haemorrhage and blood loss.
  - Handle tissues gently and carefully
  - Use subcuticular skin sutures + tissue glue, so no protruding sutures they can chew and remove
- Recovery
  - Maintain use of heat pad or place in heated enclosure
- Keep isolated from cage mates for 7-10 days to avoid any excessive exercise and wound breakdown.

GUINEA PIGS

The guinea pig (*Cavia porcellus*) is a small South American rodent belonging to family *Cavidae* and. They are a member of the rodent suborder *Hystricomorph* that includes porcupines and chinchilla.

It is neither threatened nor endangered in the wild - in fact they are still hunted and cooked for food as part of the Andean culture.

Many experienced breeders resent people using the name Guinea Pig (as they are NOT a pig!) and prefer the named Cavy.

As a pet they rarely bite or scratch and as they are unable to climb or jump, they can be housed easily. In Australia the guinea pig is kept as a pet and also used for research.

Guinea Pig Biology

Males are called Boars, Females are called sows, while juveniles are called pups or young (never piglets).

Table 1. Guinea Pig Vital Data

Life Expectancy	5 – 9 years (average 5-6 yrs)
Adult Body Weight	Male: 900-1200g, Female 700-900g. depending upon breed
Gestation	59 – 72 days
Litter Size	1 – 13 (average 4). The young are born precocial (fully furred and both eyes open)
Weaning	3 weeks
Sexual Maturity	Male 3 - 4 months, Female 2 - 3 months
Rectal Temp	36.5-39.5 ^{o}C
Heart Rate	240 - 310

Respiratory rate	40 - 100
Tidal Volume (ml/Kg)	2.3 – 5.3
Blood Volume (ml/Kg)	70
Blood Pressure: Systolic/Diastolic (mm Hg)	80 – 94 / 55 - 58
Water Consumption (ml/Kg/day)	80 - 220
Food Consumption (g/Kg/day)	60

Feet have distinct, hairless footpads. There are 4 toes on the forelimb and 3 toes on the hindlimb.

Guinea pigs are social animals living in groups of 10-12. They always establish a pecking order in each group, frequently dominated by a large adult alpha male (boar). Stress and/or overcrowding can lead to aggression, and entire adult males will display aggression towards other males if there are females in the group.

Guinea pigs are prone to stress with any environmental changes and barbering of each other’s fur will be a sign that stress is a likely problem.

Guinea pigs natural flight response is to hide in a burrow, so they prefer a hide-box or tunnel to hide and rest – cardboard or wooden boxes, PVC pipes or deep layers of substrate such as shredded paper, straw and hay are useful for this. Provide at least one hide for each guinea pig in the enclosure.

Guinea pigs like to wander and explore their environment so allowing them outside their enclosure to wander is of benefit. Be careful of any potential hazards such as electrical cords as they will chew on anything as this is an important natural way they explore a new environment.

Husbandry

A guinea pig enclosure should be at least 1200 cm^2 with a minimum 25-30 cm height for walls – note this is a minimum recommendation and there is a strong preference for it to be 3-4 times this size. Guinea pigs cannot climb or jump so they can be housed in an open top enclosure as long as potential predators do not have access.

The enclosure should have a solid floor (avoid wire floors as they damage feet).

Recommended items to use as bedding/substrate on the floor can be:

- Shredded newspaper
- Grass hay
- Wood shavings (avoid aromatic shavings or wood treated with copper arsenate etc.)
- Processed corn cobs
- Soft Tissue paper
- Paper Pellets - Kitty litter made from recycled newspaper (e.g Breeders Choice ®)
- Take care with straw as it may contain sharp awns that will lacerate foot pads.
- Avoid sawdust as it becomes entrapped in the prepuce and cause impaction around the penis

Guinea pigs do not have a strong odour from their faecal pellets, so changing substrate at least once weekly (or daily if required) is usually recommended. As with rats and mice ventilation is important to alleviate any build up of Ammonia from urine deposits - guinea pigs are very sensitive to the ammonia. levels in their environment.

Guinea pigs should have fresh water at all times. Consider the use of two or more water bottles or sippers in case on is accidentally spilt. Check the water bottle frequently as guinea pigs like to play with the sipper tube which may cause leakage. Sometimes they even push food up the sipper tube!

Heat stress is an important problem in guinea pigs. They have evolved to hiding in cool burrows so they have poor mechanisms for dispersing heat and become easily stressed with temperatures over 25^{o}C for other than a short time. Aim to provide an ambient temperature range of 18-25^{o}C

Handling

Before any handling, wash your hands well to remove any persistent odour from predator species you may have been handling previously (dogs, cats, reptiles etc.).

Guinea pigs have an easy and friendly personality, so they rarely bite or scratch – juveniles may nip. They have a strong natural curiosity, so they often will come over to investigate a hand placed in their enclosure. They are relatively easy to scoop into the palm of your hand. I often use a towel to restrain them for a physical examination – some prefer their head out, others calm down when their head is covered. A frightened guinea pig may jump and run, but rarely become aggressive – observe them closely when on your examination table that they do not suddenly launch themselves onto the floor. They often vocalise while being handled.

Most guinea pigs resent any handling and will scream and squeal so loudly that clients may be concerned – the only way I can cope with this is to warn the client that this will happen prior to restraining the guinea pig and reassure them when the problem arises.

Feeding

Guinea pigs are herbivores and graze in the wild. An appropriate diet for guinea pigs is based on a high fibre diet of fresh vegetables & hay. Guinea pigs are more efficient at digesting fibre than rabbits. They are crepuscular and consume more food in late afternoon or the early evening.

Guinea pigs perform caecotrophy, usually at night, and may eat up to 40% of their total faeces. They are monogastric with a large caecum and produce two different forms of faecal pellets:

1. Originating from the caecum:

- Soft consistency
- High in Nitrogen
- This is the bulk of the caecotrophy

2. Originating from the bowel

- More fibre dense
- similar to normal faces in other mammals

The most appropriate diet for guinea pigs is:

- Ad libitum fresh grass or grass hays (Timothy, Meadow, Ryegrass, Oaten, Wheaten, Paddock or Pasture hays) should be provided daily.
    - Avoid large volumes of legume hays such as lucerne or clover hays, as they have too high a content of protein and calcium. However these hays are suitable for juvenile, lactating or pregnant animals, which require the higher levels of protein and calcium.
- A wide range of fresh vegetables & herbs.
    - Broccoli, cabbage, celery, endive, beetroot or carrot tops, Brussels sprouts, silverbeet or spinach leaves, Bok Choy and other Asian greens, dark leaved lettuce varieties (avoid iceberg lettuce as it is basically only fibre and water with little other valuable content)
    - Herbs: parsley, dandelion, coriander, basil, dill, mint.
- Small volumes of high quality guinea pig mixes or pellets
    - must not have added sugar or molasses
    - fibre content > 15%.
    - It is important to limit the volume provided or obesity may result.

Vitamin C

Guinea pigs share with Humans (and most primates) the unique problem of being unable to synthesize Vitamin C.

- Require this vitamin daily from their diet.
    - at least 30mg/kg/day for growing or pregnant animals
    - 10mg/kg/day as maintenance for adults
- Provide a daily supply of fresh vegetables with some cabbage or orange as a simple means of supplementing their diet with Vitamin C

Commercial pellets and guinea pig feeds often have added Vitamin C, but it is quite labile and so will deteriorate with time and storage conditions.

Sexing

At first cursory glance Guinea pigs may appear difficult to sex, but with a close inspection it is quite easy.

- ***Male guinea pigs***
  - large scrotal pouches containing large testes
  - longitudinal narrow slit at perineum that is junction of two scrotal pouches in midline
  - penis easily everted with gentle pressure at the base
- ***Female guinea pigs***
  - Y shaped depression in perineum
  - Top branches of Y point cranially and surround the urethral opening
  - Vulva opening is at the intersection of the branches. Have an epithelial vaginal sealing membrane that opens at oestrus, parturition and mating.
  - Anus is at the base of the Y
  - Females are usually smaller than males
  - After mating, a copulatory plug develops in the vagina. It is a combination of male vesicular gland fluid and vaginal epithelium. It usually falls away several hours after mating.
- ***Immature animals***
  - Male anogenital area has shape of an upside down exclamation mark
  - Female it is Y shaped with the vulval opening sealed by a membrane.

Reproduction

Males are not fertile until around four months of age.

Female guinea pigs MUST be bred before seven months of age or not at all.

Oestrous cycle

- Polyoestrous, Spontaneous ovulation
- Cycle lasts 13 - 25 days.
- Female is receptive to the boar only 8-15 hours of this cycle.
- Sows experience a post-partum 'heat' a few hours after giving birth.
- This is why they are such prolific breeders, the female is nursing one litter and is pregnant with another litter.

***Gestation*:** lasts between 59 and 72 days. The gestation period is shorter with larger litters and longer with small litters.

- Pregnant sows display a grossly enlarged abdomen in late pregnancy.
- Her body weight may actually double during pregnancy
- Timing of delivery is difficult to assess in guinea pigs due to the relatively long gestation period and lack of nest building by the sow.
    - Within one week prior to delivery
        - Widening of pelvic area can be palpated – up to 2.5 cm in the last 10 days.
    - Uncomplicated delivery
        - lasts about one-half hour
        - average of five minutes between babies.
    - Litter sizes range 1 – 6 (average 3 – 4)
    - First time litters are usually very small.
    - Abortions and stillbirths are not uncommon.

The young are precocial (very well developed at birth - they weigh between 70 -100 grams and have a full hair coat). Young are born with teeth erupted and both eyes open

Mothers have only a small maternal investment – they do not build a nest and are not attentive mothers usually. Many sows are in a sitting position while young are nursing. Weaning is around 3 weeks of age despite the fact that thy will consume solids soon after birth. With poor mothering, young need milk for a minimum of 3-4 days and can survive on solids alone after 5 days.

The food they are exposed to in the first weeks determines what they will eat for life, so it is recommended to provide a wide range of different foods during this period.

Guinea pigs should be desexed early as males and females reach puberty at 3 and 2 months respectively.

COMMON PROBLEMS IN GUINEA PIGS

1. External Parasites (Fleas, Lice and Mites)

Lice and mites are common external parasites of guinea pigs.

The commonly found lice are *Cliricola porcelli* and *Gyropus ovalis*. Adult lice and their eggs are commonly detected attached to hair shafts of affected animals. These lice infestations often go unnoticed, but severe infestations are accompanied by excessive itching, scratching, and some hair loss. Look for scabs forming around the margins of the ears. Two species of biting lice infest Guinea pigs. Their biting habit causes damage to the skin and this leads to secondary infection and pruritus. The best treatment for lice is permethrin (Permoxin, Dermcare) dilute 1:40 with water. Apply and then rinse well. Repeat in 7-14 days.

Mite infestations are usually more severe than lice. The most common mite is *Trixacarus caviae*. Overseas publications state that mite infestation is uncommon – this is not the case in Australia – it is a very common problem here.

Always suspect *T. Caviae* in any guinea pig presented with scratching or skin lesions.

Clinical Signs

T. caviae is a sarcoptid mite living in the upper skin layers. The life cycle is 14 days. Mite eggs can remain dormant for up to 21 months.

This mite causes intense pruritus and scratching especially around head and shoulders. The result is significant areas of alopecia. A small number of cases do not present with pruritus but have alopecia and excessive crusting and scale present.

Some cases have severe pruritus to the extent that the animals run around wildly in circles and are constantly scratching. These may be misinterpreted as “fits” by an owner.

Transmission is by direct contact so most infestations begin with the introduction of a mite infested guinea pig.

Typical presentations of *T. Caviae* infestations

1. Alopecia and pruritus a few weeks post introduction or purchase of a new guinea pig

2. Resident older guinea pigs with onset of alopecia and pruritus. These are likely been harbouring the mite for some time. They may be less immunocompetent because of age or many are developing Vitamin C deficiency and this allows the infestation to erupt.

Diagnosis

- skin scrapings
  - Perform several Superficial and DEEP scrapes
  - Superficial scrapes alone may miss the mite

Treatment

- Selamectin topically (Revolution®, Pfizer) 10mg/kg
- Bath each 2-3 weeks with a medicated keratolytic shampoo (Malaseb or Sebolyse)
- Antibiotics are rarely necessary, even with severely traumatised skin lesions.

1 a. Other Ectoparasites

Fleas (*Ctenophalides* spp.) – treat with Fipronil (Frontline Spray (Merial)

1 b. Differential diagnosis for skin problems in guinea pigs:

- Vitamin C deficiency (Scurvy)
    - History of diet components
    - May predispose to *T. caviae* infestation
- Hair loss in pregnant/recently pregnant female
    - Usually with females in poor condition or repeatedly bred
    - Alopecia usually not symmetrical
- Cage mate aggression.
    - wounds dorsally between the shoulder blade and/or barbering.
    - differentiate from mange
        - skin scrapes
        - trial separation.
- Fungal infection
    - Most common *Tricophyton mentagrophytes*
    - Scaly lesions with broken hairs, more often occur around the head
    - No pruritis
    - NB: these dermatophytes will NOT fluoresce under a Wood’s lamp.
- Cystic ovaries
    - Females affected
    - Bilaterally symmetrical alopecia along the dorsum
    - Swollen abdomen (to confirm)
    - Suppressed fertility
    - lethargy
    - May be pathologic or normal clinical findings.
- ***Trixacarus caviae***.

1 c. Cystic Ovaries

Large cysts can be palpated and confirmed with radiograph or ultrasound.

Treatment

- Surgery – ovariohysterectomy
- Palliative treatment
    - Percutaneous aspiration of cyst contents (ultrasound guided)
    - HCG or GnRH analogues: Leuprorelin Acetate (Lucrin 5mg/ml, Abbott) – 25ug/guinea pig x 2 injections (2 weeks apart).

1 d. Dermatophytes

Trichophyton spp. or *Microsporum* spp. are the common fungi detected. These are an uncommon skin infection and should be detected with skin scrapes and Trichogram as with other animals. Treatment is anti-fungal baths with miconazole/chlorhexidine solutions (Malaseb, Dermcare) or Enilconazole (Imaverol). Apply the solution and work into a lather, leave for 10 minutes, then rinse well. Repeat twice weekly for 2 weeks. Severe unresponsive cases can be also be treated with oral Grisefulvin 100mg/kg PO sid.

1 e. Behavioural Alopecia

- Boredom
    - More common in guinea pigs housed alone.
- Barbering (Hair Chewing)
    - One or several guinea pigs chew on the hair coats of other guinea pigs that are below them in the pecking order.
    - May have signs of ear chewing as well
    - The normal, full coat identifies the dominant culprit/s while others have areas of alopecia.
    - Treatment:

        - removing and separating the dominant guinea pigs
        - provide sufficient quantities of hay, lack of good access to hay can exacerbate barbering

2. BACTERIAL PODODERMATITIS (FOOTPAD INFECTION)

Severe infections of the footpads are often present among guinea pigs housed in cages with wire flooring. Faecal soiling of the feet and wire exacerbates the problem. The front feet are most vulnerable to this condition.

Clinical Signs

- Significant swelling of the feet
- Lameness and reluctance to move

Complicating factors

- Obesity
- Lack of mobility
- Inappropriate substrates
    - Abrasive floors – wire commonly implicated
    - Wet or dirty floors – poor hygiene and sanitation

Treatment

- Provide soft bedding
    - Shredded newspaper, grass hays, straw, recycled paper pellets
- Improve hygiene and sanitation
- Address underlying causes
    - obesity if present – provide balanced diet
        - fresh grass
        - grass hay
        - fresh leafy vegetables
        - high quality guinea pig pellets
    - Supplement Vitamin C
    - Check for dental disease

- Treat feet lesions
  - Topical dressing with Silvazine® (silver sulphadiazine & chlorhexidine digluconate) ointment
  - Bandages
    - Allevyn (Smith & Nephew) as primary wound contact.
    - Light gauze as secondary layer
    - Vetrap (3M) as tertiary layer
    - Monitor for constriction, soiling or slipping.
    - Replace bandages each 1-2 days.
- Treat Secondary Infection
  - Usually organisms such as *Staph aureus*.
  - N.B: Beware some antibiotics in guinea pigs.
  - Usually use a combination of antibiotics
    - Enrofloxacin (Baytril, Bayer) 10-15mg/kg PO bid
    - +/- Metrondazole (Flagyl-S, Aventis) 20mg/kg PO bid
    - +/- Chloramphenicol 50mg/kg PO bid.
  - Topical antibiotics
    - Soaking in 0.05% Chlorhexidine solution
    - Fusidic Acid (Fucidin, CSL)
    - Silver Sulphadiazine + Chlorhexidine digluconate (Silvazine® ointment, Smith & Nephew)
    - Manuka Honey (Active Honey)
- Analgesia, depending on severity of pain displayed – use either or both of:
  - Meloxicam (Metacam oral, Boehringer Engelheim) 0.1-0.5mg/kg PO sid
  - Tramadol Hydrochloride (Tramal, CSL) 10mg/kg PO sid
- Therapy may have to be carried out for a lengthy period of time for full recovery. Possible complications of this condition include osteomyelitis and arthritis.

3. SCURVY (VITAMIN C DEFICIENCY)

Guinea pigs are unable to form Vitamin C so they must regularly receive an adequate supply in their diet. Vitamin C is necessary for collagen synthesis so deficiency affects several body systems.

Clinical Signs

- poor appetite
- swollen, painful joints and ribs
- reluctance to move (appears as if hindlimb paresis)
- diarrhoea
- rough or unkempt hair coat and alopecia
- poor bone and teeth development (seen as dental malocclusion and inappetence)
- delayed wound healing
- spontaneous bleeding especially from the gums, into joints, and in muscle.
- left untreated, it can be fatal especially to rapidly growing young and pregnant females.
- A subclinical deficiency may predispose to other diseases.
- Radiography may reveal widening of epiphyses, of long bones and costochondral junction of ribs

Treatment

Vitamin C is very labile and even in well stored food (cool and dry environment) can drop to half the potency in as little as 6 weeks.

The Vitamin C content of commercial foods is unreliable so all guinea pigs need daily supplementation in their diet. Provide fresh leafy green vegetables and fruit rich in Vitamin C.

- Growing or pregnant animals need 30mg/kg/day
- Maintenance for adults is 10,mg/kg/day
- Animals with scurvy may require 50mg/kg/day.
- Vitamin C can be supplied in food, water, or by injection.

4. GREASY SEBORRHOEA

There is a concentration of sebaceous glands along the dorsum and rump and anus. Boars often have an accumulation of sebum here causing matting, malodour and local infection in this area.

Treatment is cleaning with surgical alcohol, methylated spirits or alcohol-based gel hand cleansers as required.

5. DIARRHOEA

True enteritis involving the small intestine is not common in guinea pigs.

5a. Soft Stools

The most common problem with faces is presence of 'soft stools'. Many clients mistake this for diarrhoea.

- This usually has a dietary cause.
    - Insufficient fibre
    - Excessive carbohydrate (fruit, grains etc.)
    - Sudden changes in diet

5b. Bacterial Infection;

- Several bacteria are capable of causing infections of the gastrointestinal tract in guinea pigs.
- Many are introduced through contamination of food or water.
- Common bacteria include: *Salmonella, Campylobacter,C lostridium, E. coli, Pseudomionas,Yersinia pseudotunerculosis, Arizona, Listeria*.

Clinical Signs

- Diarrhoea
- Weight Loss
- Lethargy
- Sudden death

Diagnosis

- Faecal flotation
- Culture & Sensitivity

Treatment

- Supportive care
- Antibiotic therapy based on C & S results

5c. Dysbiosis from Inappropriate use of Antibiotics

Guinea pigs are extremely sensitive to antibiotic use. Their normal gut flora is mostly gram positive and these are easily eradicated by commonly used antibiotics. When the normal flora is gone, there is commonly an overgrowth of *Clostridium dificili* that releases a toxin causing death - Antibiotic induced Enterotoxaemia.

Antibiotics to Avoid: penicillin, ampicillin, cephalosporins, lincomycin, clindamycin, chlortetracycline, streptomycin, erythromycin, vancomycin, spectinomycin.

Antibiotics recommended for use in Guinea pigs:

- Enrofloxacillin (Baytril) @ 10mg/kg sid or bid
- Trimethoprim/Sulphonamide combinations

Try to use antibiotics for as short a time as possible and only if indicated.

6. HEAT STRESS (HEAT STROKE)

Because of their habit of living in burrows in the wild, guinea pigs are poor at shedding heat. This makes them very susceptible to heat stroke. Long coats and obesity can be complicating factors.

Conditions promoting heat stroke:

- Ambient temperatures > 28^{o}C and relative humidity > 70%
- Poor Husbandry
  - inadequate shade
  - Poor ventilation
  - Overcrowding
  - Stressors

Clinical Signs

- Panting
- Weakness
- Slobbering
- Lethargy & reluctance to move
- Convulsions, and ultimately, death.

Treatment

- Bathe in cool water
- Misting and spraying with cool water
- Apply alcohol to extremities and allow to evaporate
- This is a treatable condition if recognized early. Heat stressed guinea pigs should be misted with cool water, bathed in cool water, or have alcohol applied.

Prevention

- Maintain in air conditioned room
- Plastic bottles containing frozen water & stored in freezer can be supplied in hot weather to allow guinea pigs to cool down.

7. DENTAL DISEASE / SLOBBERS / DENTAL MALOCCLUSION

The guinea pig dental formula is 2 (I1/1, C0/0, PM1/1, M3/3) = 20. The main contributors to dental problems are:

- Inappropriate diet
- Congenital malocclusions
- Trauma
- Vitamin C deficiency

'Slobbers' is caused by constant drooling of saliva as a result of dental disease – the fur on ventral neck and anterior thorax is permanently wet and matted.

More common in guinea pigs of 2-3 years age

Response to overgrown premolars and/or molars that lacerate the tongue and mucosa.

Diagnosis

- Thorough and close examination of the mouth and teeth – usually requires anaesthesia or heavy

Treatment

- Requires specially designed equipment to work in such a small oral cavity
- Mouth gag and cheek pouch dilators are a minimal requirement
- Trim and file overgrown teeth edges
- Assisted feeding with commercial products such as Oxbow Critical Care for Herbivores® may be necessary in recovery phase. (www.oxbowaustralia.com)
- antibiotics as indicated
- adjust diet to more appropriate components

For many advanced cases, a permanent solution is not available, so regular trimming may be required. This is difficult and demanding surgery and in advanced cases they should be referred to experienced veterinarians.

Highly recommended text: Capello V, (2005). *Rabbit and Rodent Dentistry Handbook*. Zoologocal Education Network. www.exoticdvm.com.

8. RESPIRATORY INFECTIONS

Respiratory infections are a common problem in guinea pigs. They can be caused by a range of viral and bacterial agents:

- *Streptococcus pneumoniae*
- *Bordetella bronchiseptica*
- *Gram-positive diplococcus.*

These organisms are part of the normal flora of guinea pigs, so they are commonly opportunistic infections caused by inappropriate environmental conditions and diet contributing to stress.

Note on *Bordetella bronchiseptica* – this organism is often present in healthy rabbits and is the reason why some people don't recommend keeping rabbits & guinea pigs housed together. It has also been recorded as causing otitis media, conjunctivitis, abortion and stillbirths.

Clinical Signs

- Dyspnoea
- Nasal and ocular discharge
- Sneezing & wheezing,
- Anorexia/Inappetence
- Lethargy & depression
- Sudden death.
- Middle or inner ear infections may also be seen (*Streptococcus pneumoniae)*
    - Torticollis or head tilt
    - Incoordination
    - Circling and rolling to one side.

Treatment

- Supportive care
- Supplement with Vitamin C
- Address poor husbandry
- Perform C&S provide appropriate antibiotic. Initially provide one of :
  - Chloramphenicol 50mg/kg PO bid.
  - Enrofloxacin 10mg/kg PO bid.
  - Doxycycline 2.5-5mg/kg PO bid.

9. DYSURIA

The most common causes of dysuria in guinea pigs are urolithiasis and cystitis.

9a. Urolithiasis

Females are more commonly affected. Crystals are commonly found in urine – Calcium carbonate ($CaCO_3$) and Struvite (NH_4MgPO_4) are most common. The cause of urolith formation is not known. Oxalate urolithiasis is the most common form. Normal urine is alkaline pH = 8.5-9.0

Clinical Signs

- Inappetance
- Weakness
- Reluctant to move
- Weight loss
- Haematuria
- Stranguria
- Urine on perineal area

Diagnosis

- Radiography
    - Calcium uroliths are radio-dense
- Ultrasonography
    - Assess hydronephrosis and hydroureter
- Cystocentesis
- Assess renal function
    - CBC and Biochemistry

Treatment

- Surgery to remove uroliths
- Main problem is the rapid return of the uroliths – as quick as 4-6 weeks
- Post-op diet modifications to reduce urolith formation
    - Reduce calcium and oxalates provided
    - Increase diuresis
        - Supply fresh green leafy vegetables with extra misting
        - Add unsweetened fruit juice to drinking water to increase palatability and so increase total intake
    - Add citrate to diet – 50-150mg/kg/day divided PO bid.
        - An inhibitor of crystal formation
    - Avoid excessive Vitamin C
        - Vit C + calcium or oxalate may enhance crystal formation
    - Treat any urinary tract infection
        - Sample for C&S from bladder wall during surgery

9b. Cystitis

This is usually caused by bacterial infection and is commonly secondary to urolithiasis.

Clinical Signs

- More common in older females.
- Haematuria
- Stranguria

Diagnosis

- Cystocentesis
  - Urinalysis
  - Urine C&S
    - Common causes, *E.coli*, *Streptococcus spp*, *Staphylococus spp.*
- Radiography and Ultrasonography to rule out uroliths

Treatment

- Antibiotics based on C&S

10. CERVICAL LYMPHADENITIS

Infection with *Strep. zooepidemicus* causes lymphadenitis in cervical lymph nodes and abscessation. This is a part of normal flora of the oropharynx. Explore source of potential abrasives or damage to oral mucosa in history.

Clinical signs

- Swelling ventral neck region
- Purulent discharge may be present from the affected node.

Treatment

- Surgical excision or drainage of the affected node.
- Antibiotics: Chloramphenicol 50mg/kg PO bid.
- Warn client of zoonotic potential

11. PREGNANCY TOXAEMIA

Is most commonly seen in pregnant females or non pregnant, obese guinea pigs.

Clinical Signs

- Depression, weakness
- Anorexia/Inappetence
- Seen in late pregnancy of soon after delivery of pups.
- Convulsions may occur if severe
- Mortality can be high

Diagnosis

- Blood Glucose = Hypoglycaemia
- Urinalysis
    - Ketonuria and proteinuria.

Treatment

- Fluid Therapy
    - Warmed dextrose/saline fluids
    - Preferably IV - otherwise IP or SC.
- Oral glucose & assisted feeding with Oxbow Critical Care for Herbivores®
- Once stabilised perform laparotomy for caesarean section or ovariohysterectomy.

Prevention

- Avoiding overfeeding & obesity – provide appropriate diet.
- Avoid stress or fasting during pregnancy.

12. INAPPETENCE

Inappetence can be found with many diseases but it is a common cause of presentation at a veterinary clinic.

Inappetence should always be treated as a serious problem because guinea pigs can develop serious complications after only a small period of not eating. Hepatic lipidosis can develop within 24-48 hours if there is no access to food or caecotrophs.

Many cases need to be given fluid and food supplements while you investigate the cause of the inappetence.

Initial Examination

Check that the guinea pig is actually has a depressed appetite or does it have difficulty eating (dysphagia). Inappetent guinea are usually not bright, alert and responsive while dysphagic guinea pigs can be bright alert and responsive. Always check for signs of dental disease.

Ileus or gut stasis can be seen with inappetence.

Treatment of Ileus

- Warmth – provide extra heat to avoid hypothermia
    - Use heat pads, bubble-wrap or heated air.
    - Provide air-conditioning
- Fluid Therapy
    - IV or subcutaneous fluids
- Supplemental Feeding
    - Provide normal good quality food (hay, fresh grass and fresh green leafy vegetables
    - Assisted feeding with commercial products such as Oxbow Critical Care for Herbivores® may be necessary. (www.oxbowaustralia.com)
        - Syringe feed 50ml/kg/day in multiple divided doses
        - High fibre content stimulates GIT movement

- Analgesia
    - Offer ASAP as they respond well
    - NSAIDs
        - Meloxicam (Metacam, Boehringer Ingelheim) 0.1-0.5mg/kg PO/SC sid
        - Make certain is well hydrated before supplying NSAIDs.
    - Opiates
        - Tramadol hydrochloride (Tramal, CSL) 10,g/kg PO sid
        - Buprenorphine (Temgesic, Reckitt Benckiser) 0.05mg/kg SC bid-tid.
        - Butorphanol (Torbugesic, Fort Dodge or Dolorex, Intervet) 2mg/kg each 2-4 hours as required.
- Stimulate gut movement
    - Use gut prokinetics with care especially if suspect an obstruction
    - Cisapride 0.5mg/kg PO bid
        - Not available commercially but can be procured from compounding pharmacists.
    - Metoclopramide (Metomide, Delvet) 0.5mg/kg PO tid-bid

13. ENDOPARASITES

Endoparasites are usually not a common problem in guinea pigs.

- Coccidiosis may be seen with diarrhoea
- Cryptosporidia & Ascarids seen occasionally and may be pathogenic
- Annual faecal examination can be recommended to assess these.

NOTES:

NOTES:

Chapter 11

Avian Case Reports

Dr Michael Cannon

This session will use case material to demonstrate the use of standard haematology and biochemistry results as an aid to achieving a diagnosis.

The first case is based on a presentation developed by Dr Bob Doneley, Toowoomba.

The Appropriate Use of Diagnostic Testing in Avian Medicine

Birds are limited in their physical expression of clinical signs of disease. Avian vets often use diagnostic testing more than other veterinarians. However, diagnostic testing should be seen as PART of the diagnostic process - not the WHOLE process.

Molly the Macaw taken from VIN, presented by BL Speer

Molly is an 11 yr female Blue & Gold Macaw, she presented as a second opinion for feather-picking that had been in place for 4 months. Her diet was commercial parrot pellets, some seed, vegetables. She has signs of feather-picking resulting in alopecia around legs, thighs, abdomen & chest

First workup by referring vet - 1st day, standard workup

- CBC
- Biochem panel
- radiographs
- chlamydia PCR
- Polyoma PCR
- Pacheco's PCR
- PCD PCR

- Aspergillus Ab & Ag
- DNA sexing
- Blood Pb
- Blood Zn
- Giardia faecal IFA
- faecal flotation

Results

- leucocytosis (22,000)
- hypercalcaemia
- mild hyperamylasaemia
- hyperkalaemia
- CPK slightly elevated
- rads - gonadal enlargement
- DNA - female (still!)
- Aspergillus - low +ve Ag
- Polyoma, PCD, Pacheco's, Chlamydia - all negative
- Giardia & Faecal flotation negative
- Pb normal
- Zn levels toxic (?) - marginally elevated

Treatment

Molly was treated with DMSA, Itraconazole, Enrofloxacin. But unfortunately she is still feather-picking four months later

Now owners want a second opinion...

Estimated cost of all tests: US$1,000 …… with no diagnosis …..

and now owner will not allow further testing!

Has the large number of diagnostic tests helped this bird and its owners?

Or could a more appropriate selection of tests have achieved the same result at half the cost?

In this case:

- Behavioural history revealed evidence of sexual behaviour
- hypercalcaemia indicated probable reproductive activity
- leucocytosis & high Amylase, combined with the above, indicated possible yolk peritonitis
- tentative diagnosis
    - sexual featherpicking and
    - possible abdominal pain leading to picking

Tests that lead to this conclusion

A good history & physical examination + CBC/Biochemistry panel.

The money spent on other diagnostic tests could have been used to focus more on the reproductive tract eg endoscopy, laparotomy.

In Summary:

- Use diagnostics in a step by step approach. This allows you to consider:
- cost
- patient safety
- refined focusing of diagnostic effort

Select tests based on:

- likely significance & reliability of the results
- safety
- lab turnaround times
- reliability of the lab and the test
- cost

And remember…..

Testing is part of the diagnostic process

NOT THE WHOLE

In the following cases presented, the answers are not as important as an exploration and understanding of the process.

Avoid the temptation to look at the answer for each section before progressing. The thought processes you use and the practice this provides is the main benefit here.

CASE 1:

History: Superb Parrot (*Polytelis swainsonii*) purchased 2 weeks previously from a bird dealer acting on consignment for a bird breeder who hand-rears them and sells them as pets. Bird has been off colour for approximately 1 week. Owner thought it was just bird settling into a new environment. The bird became much worse overnight. It is not eating food and is quite weak. The owner mentions that the bird and the cat are good friends and the bird often eats from the cat's bowl.

Physical Examination: Bird is thin with a prominent keel. Weight is 78g. Bird is ataxic when walking on the examination table. Urates are a bright green and there is excessive urine, faecal component is poorly formed.

Lab results:

Parameter (SI units)	Value	Normal Range	Interpretation
WBC x 10^9/L	15	3.0 - 8.0	leukocytosis
Bands x 10^9/L	0.3 (2%)	0	slight left shift
Heterophils x 10^9/L	10.05 (67%)	2.4 - 6.6	heterophilia
Lymphocytes x 10^9/L	2.55 (17%)	1.0 - 4.6	
Monocytes x 10^9/L	0.45 (3%)	0 – 0.1	
Eosinophils x 10^9/L	0	0 – 0.1	
Basophils x 10^9/L	1.5 (10%)	0 – 0.1	
PCV L/L	0.38	0.45 – 0.57	anaemia
TPP g/L	45	25-50	
SGOT (AST) u/L	3814	139 - 390	raised – liver, muscle, kidney?
Uric Acid umol/L	743.5	210 - 650	Slight increase over normal
CK u/L	156	120 - 420	normal – rules out muscle damage

Faecal Gram Stain Normal numbers of bacteria and most are Gram Positive cocci

Comments slight polychromasia (1+), slight anisocytosis, many toxic heterophils are present

TPP assessed via refractometer (normal for most species = 2.5-5.0 g/dL.)& converted to SI units = Refractometer value X 10 = g/L (25-50)

AST, UA & CK = derived from Reflotron & converted to SI units.

AST= Reflotron value X 1

UA = Reflotron value (mg/dL) X 59.48 = umol/L (210-650)

CK = Reflotron value X 1

CONSIDER ALL THE INFORMATION AND THESE RESULTS, BEFORE TURNING THE PAGE

1.1 What diseases do you initially suspect?

1. ____

2. ____

3. ____

1.2 Laboratory tests Interpretation:

____

____

____

____

____

____

1.3 Is there something you could do to confirm the possible diagnosis?

____

____

____

____

____

____

1.4 YOUR DIAGNOSIS? : ______________________________

NOTES:

1.1 What diseases do you initially suspect?

The history and species suggest:

- Hand-reared bird – Candidiasis? Gram Negative septicaemia? - both less likely after normal Gram stain results
- Eating from cat's bowl – *Pasteurella* ? - no sign on Gram stain, would be Gram negative bacilli or coccobacilli
- Changes to faeces and species supports a diagnosis of Chlamydia – All *Polytelis* are prone to Chlamydia infection and an Ascarid burden. Green discoloration of urates (biliverdinuria) and diarrhoea also suggests chlamydia.

1.2 Laboratory tests Interpretation:

- Polychromasia and anisocytosis support regenerative anaemia
- Raised AST consider possible muscle, liver or renal disease
- Normal CPK reduces risk of muscle disease or damage
- Uric Acid is just over normal so is likely to be due to increased catabolism associated with anorexia, would expect to be significantly higher with renal disease
- High WBC with band cells present and toxic heterophils + anaemia with raised AST but normal CPK & UA is often indicative of Chlamydophila infection

1.3 Is there something you could do to confirm the possible diagnosis?

- Use Clearview Chlamydia Test = Strong Positive
- Immunocomb is less reliable at this stage of active infection, as the antibody titre may not yet have risen
- Could use Chlamydophila PCR if available

1.4 DIAGNOSIS: Chlamydia infection
(Psittacosis, Chlamydophilosis)

Case 2:

History: A pet 2-year-old Galah is presented with sudden onset of illness. "Bird was fine yesterday". It is weak and anorexic, sitting huddled on the bottom of the cage.

Physical Examination: Bird is thin with a prominent keel. Weight is 92g. Bird is not interested in walking on the examination table. No droppings are present in the cage. Crop is empty.

Lab results:

Parameter (SI units)	**Value**	**Normal Range**	**Interpretation**
WBC x 10^9/L	3.0	3.0 - 8.0	
Bands x 10^9/L	0	0	
Heterophils x 10^9/L	0.06 (2%)	2.4 - 6.6	
Lymphocytes x 10^9/L	2.19 (73%)	1.0 - 4.6	
Monocytes x 10^9/L	0.75 (25%)	0 – 0.1	
Eosinophils x 10^9/L	0	0 – 0.1	
Basophils x 10^9/L	0	0 – 0.1	
PCV L/L	0.41	0.45 – 0.57	
TPP g/L	12	29-42	
SGOT (AST) u/L	1165	139 - 390	
Uric Acid umol/L	951.68	210 - 650	
CK u/L	182	120 - 420	

Faecal Gram Stain	Normal numbers of bacteria and most are Gram Positive cocci
Comments	slight polychromasia, slight anisocytosis,

TPP assessed via refractometer (normal for most species = 2.5-5.0 g/dL.)& converted to SI units = Refractometer value X 10 = g/L (25-50)

AST, UA & CK = from Reflotron & converted to SI units.

AST= Reflotron value X 1

UA = Reflotron value (mg/dL) X 59.48 = umol/L (210-650)

CK = Reflotron value X 1

Work through these results and make an interpretation in the space provided, before turning the page

CASE 2 INTERPRETATION

Parameter (SI units)	Value	Normal Range	Interpretation
WBC x 10^9/L	3.0	3.0 - 8.0	leukopaenia
Bands x 10^9/L	0	0	
Heterophils x 10^9/L	0.06 (2%)	2.4 - 6.6	heteropaenia
Lymphocytes x 10^9/L	2.19 (73%)	1.0 - 4.6	High %, Normal absolute count
Monocytes x 10^9/L	0.75 (25%)	0 – 0.1	Slight raised absolute count
Eosinophils x 10^9/L	0	0 – 0.1	
Basophils x 10^9/L	0	0 – 0.1	
PCV L/L	0.41	0.45 – 0.57	Mild Anaemia
TPP g/L	12	29-42	Reduced significantly
SGOT (AST) u/L	1165	139 - 390	raised – liver, muscle, kidney?
Uric Acid umol/L	951.68	210 - 650	raised
CK u/L	182	120 - 420	normal – rules out muscle damage

Faecal Gram Stain	Normal numbers of bacteria and most are Gram Positive cocci
Comments	slight polychromasia, slight anisocytosis,

TPP assessed via refractometer (normal for most species = 2.5-5.0 g/dL.)& converted to SI units = Refractometer value X 10 = g/L (25-50)

AST, UA & CK = from Reflotron & converted to SI units.

AST= Reflotron value X 1

UA = Reflotron value (mg/dL) X 59.48 = umol/L (210-650)

CK = Reflotron value X 1

2.1 What diseases do you initially suspect?

1. ____

2. ____

3. ____

2.2 Laboratory tests Interpretation:

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2.3 Is there something you could do to confirm the possible diagnosis?

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2.4 YOUR DIAGNOSIS? : ______________________________

2.1 What diseases do you initially suspect?

The history and species suggest:

- Adult bird – rule out common problems suspected in Hand-reared and juvenile birds
- Sudden onset ?– unlikely with birds weight loss and poor condition
- Bird sitting on bottom of cage with an empty crop and no faeces passed is in extreme distress and is likely to die soon. Give the client a poor prognosis

2.2 Laboratory tests Interpretation:

- Polychromasia and anisocytosis support regenerative anaemia
- Low Heterophils and WBC with a relative high Lymphocyte and Monocyte count has been observed with several overwhelming viral conditions (e.g Circovirus, Herpesvirus such as Pacheco's Disease)
- Low Protein may be due to destruction of liver tissue
- Raised CPK is likely a response to muscle tissue damage with advanced cachexia
- Uric Acid is raised. It may be due to increased catabolism associated with anorexia, or it could be early signs of renal disease, that may be secondary to the liver problem.

2.3 Is there something you could do to confirm the possible diagnosis?

- Wait until tomorrow and perform the Post Mortem Examination – send tissue samples for histopathology.
- If the bird is in a breeding situation, you may elect to sacrifice it and not wait for it to die.

2.4 DIAGNOSIS: Histopathology confirmed viral hepatopathy –
likely a Herpesvirus – possible Pacheco's.

Case 3:

History: Adult female Quarrion (*Nymphicus hollandicus*) presents with a swollen abdomen that has been present for about 1 week. She was fine until yesterday and now is quieter than normal.

Physical Examination: The bird is in good condition. Weight is 108g. There are very few droppings on the floor of the cage. The droppings contain mostly urates and very little faeces. The bird is quite depressed.

Lab results:

Parameter (SI units)	Value	Normal Range	Interpretation
WBC x 10^9/L	24.0	3.0 - 8.0	
Bands x 10^9/L	0.72 (3%)	0	
Heterophils x 10^9/L	20.88 (90%)	2.4 - 6.6	
Lymphocytes x 10^9/L	1.92 (8%)	1.0 - 4.6	
Monocytes x 10^9/L	0	0 – 0.1	
Eosinophils x 10^9/L	0.48 (2%)	0 – 0.1	
Basophils x 10^9/L	0	0 – 0.1	
PCV L/L	0.60	0.45 – 0.57	
TPP g/L	54	29-42	
SGOT (AST) u/L	1754	139 - 390	
Uric Acid umol/L	594.8	210 - 650	
CK u/L	182	120 - 420	

Faecal Gram Stain	Normal numbers of bacteria and most are Gram Positive cocci
Comments	toxic heterophils present,

TPP assessed via refractometer (normal for most species = 2.5-5.0 g/dL.)& converted to SI units = Refractometer value X 10 = g/L (25-50)

AST, UA & CK = from Reflotron & converted to SI units.

AST= Reflotron value X 1

UA = Reflotron value (mg/dL) X 59.48 = umol/L (210-650)

CK = Reflotron value X 1

Work through these results and make an interpretation, before turning the page

CASE 3 - YOUR INTERPRETATION:

Lab results:

Parameter (SI units)	**Value**	**Normal Range**	**Interpretation**
WBC x 10^9/L	24.0	3.0 - 8.0	leukocytosis
Bands x 10^9/L	0.72 (3%)	0	Left Shift
Heterophils x 10^9/L	20.88 (90%)	2.4 - 6.6	heterophilia
Lymphocytes x 10^9/L	1.92 (8%)	1.0 - 4.6	Low %, Normal absolute count
Monocytes x 10^9/L	0	0 – 0.1	Low %, Normal absolute count
Eosinophils x 10^9/L	0.48 (2%)	0 – 0.1	Mild absolute eosinophilia
Basophils x 10^9/L	0	0 – 0.1	normal
PCV L/L	0.60	0.45 – 0.57	Mild rise
TPP g/L	54	29-42	Raised significantly
SGOT (AST) u/L	1754	139 - 390	Raised
Uric Acid umol/L	594.8	210 - 650	normal
CK u/L	182	120 - 420	normal

Faecal Gram Stain	Normal numbers of bacteria and most are Gram Positive cocci
Comments	toxic heterophils present,

TPP assessed via refractometer (normal for most species = 2.5-5.0 g/dL.)& converted to SI units = Refractometer value X 10 = g/L (25-50)

AST, UA & CK = from Reflotron & converted to SI units.

AST= Reflotron value X 1

UA = Reflotron value (mg/dL) X 59.48 = umol/L (210-650)

CK = Reflotron value X 1

3.1 What diseases do you initially suspect?

1. ____

2. ____

3. ____

3.2 Laboratory tests Interpretation:

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3.3 Is there something you could do to confirm the possible diagnosis?

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3.4 YOUR DIAGNOSIS? : ______________________________

3.1 What diseases do you initially suspect?

The history and species suggest:

- Bird is in good condition so this is likely an acute onset
- Chronic egg laying is common in Cockatiels, as is Chlamydophila infection.
- Differential Dx:
    - Egg-bound or egg peritonitis
    - Abdominal mass (tumour?)
    - Liver disease
        - Fatty Liver, cirrhosis, neoplasia, Hepatomegaly/splenomegaly
    - Parasite Burden (Ascarids, Giardia)
    - Chlamydophilosis (regard most Australian species as having this until proven otherwise)

3.2 Laboratory tests Interpretation:

- Elevated WBC with heterophilia and Band neutrophils suggest active inflammation/infection
- Elevated PCV & TPP is probably dehydration (this is most likely cause of bird being depressed as well)
- Biochemistry
    - Elevated AST reflects tissue damage, combined with Normal Uric Acid & CK means less likely is renal or muscle damage. Most likely is Liver disease
- Normal Gram stain suggests problem is not within GIT

3.3 Is there something you could do to confirm your suspected diagnosis?

1. Explore breeding history details with the client.

2. Abdominal palpation for hard or soft-shelled egg

3. Abdominoscentesis if the swelling is fluctuant and excess fluid is present in the abdomen, then cytology (Gram stain and Diff-

Quik) or Culture & Sensitivity. Measure Cholesterol level in abdominal (coelomic) fluid, if it is greater than twice the blood level the diagnosis is confirmed as egg peritonitis.

4. Chlamydia diagnostics such as Clearview swab from conjunctiva, choana and cloaca. Immunocomb less likely to be useful as antibody rise may not be detectable in this early stage of the disease.

5. Abdominal Radiograph to check for presence of an egg

3.4 DIAGNOSIS:

The most fitting to the information available is Egg Bound/Peritonitis. The blood picture does not really fit Chlamydiosis & diagnostics should help rule this in or out. You would not expect liver failure due to cirrhosis or neoplasia to have such a high WBC – it is more suggestive of acute inflammation and tissue damage.

NOTES:

Chapter 12

Reptile Case Studies

Dr Michael Cannon

The first problem you will encounter when interpreting results of diagnostic tests is a reliable source of normal ranges of values. I have relied upon those produced by McCracken[1] and Fudge[2].

The following cases are to present to you how we deal with cases that we encounter in companion animal practice, with its limitations and constraints.

I wish to acknowledge the invaluable contribution of Dr Robert Johnson, South Penrith Veterinary Clinic, NSW, who provided support and the material for these cases.

Reptile Haematology Blood Collection

- Generally safe to take 0.5 to 1% of the body weight of the animal for a single blood draw
- Collection sites
    - Coccygeal veins
    - Cardiac puncture
    - Cervical and post-occipital sinuses
    - Axillary vein
    - Jugular vein vein
    - Ventral abdominal vein
- Lymph contamination often occurs during blood collection.

Lymph Contamination

- Samples will yield inaccurate CBC results but may be used for generally accurate chemistry results
- some values not accurate
    - lower albumin in lymph than whole blood

Reptile Anticoagulants

- Heparinized sample is recommended
  - decrease the chance of serum clotting
  - prevent clotting of cells for the CBC
  - provide slightly more volume of plasma for the chemistry profile.
- EDTA
  - may cause hemolysis of some reptile samples
  - not generally recommended as an anticoagulant
  - Recent research has shown that this may not apply to some species of snakes.

Reptile Haematology

- PCV
- WBC
- Differential count
- parasites
- inclusions

Reptile Biochemistry

- Newer analyzers require as little as 0.1cc of blood or plasma.
- BUN: only generally useful in chelonians
- Uric acid: indicates renal function, not always sensitive
- AST, LDH: non-specific locations
- CPK: heart, skeletal muscle
- Ca, PO4: nutritional and renal status
- Na, K, Cl: as in other species
- Albumen, Globulin, TP: liver, antigenic stimulation, dehydration, starvation, etc.
- Glucose
  - no true diabetics
  - may elevate with hepatic disease
  - low in sepsis and starvation
- Triglycerides & Cholesterol: may be high with folliculogenesis

Reptile Artefacts

- Ectoderms subject to variations in chemical parameters due to environmental changes
- New Guinea Snapping Turtles
    - have higher CK, Alb, K, PO_4
    - Animals maintained at 24.5°C than at 30.0°C

Causes of Artefacts

- Poor collection technique
- Repeated "stabbing" of muscle
    - Elevated CK and LDH
- Haemolysis
    - No effect on Na, Ca, UA, Ck
    - Elevates K, TP, Alb, AST
- Prolonged storage without separate serum
    - Decreased Glucose

Renal problems:

Diagnosis:

- Palpate large kidneys
- Biochem Profile
    - Often hyperphosphatemic (Ca:P is <1)
        - Normal > 1, first indicator of renal disease
    - Uric Acid may be normal (< 400umol/L)
        - Rise late in chronic disease
- Definitive diagnosis by biopsy
    - Generally interstitial fibrosis and is not reversible

Uric Acid

- The end product of protein metabolism in reptiles is **uric acid, not Urea**
- produced in the liver, enters the circulation, and is then secreted by renal tubules (>90%) or filtered in the glomerulus (< 10%).

- Significant loss of renal tubules
    - elevations of uric acid.
- Dehydration
    - less likely to cause hyperuricaemia
    - because glomerular filtration is relatively unimportant
- Species differences
    - carnivorous reptiles have higher normal uric acid levels than granivorous birds
- Age
    - juvenile reptiles may have lower levels than adults.
- Significant elevations
    - usually indicate renal disease
    - normal levels do not mean the kidneys are normal
    - mild increases could indicate early renal disease or dehydration (or both)

Need severe renal damage before uric acid levels begin to rise

Elevated Uric Acid

- Rehydrate the patient over 2-3 days
    - before definitively diagnosing renal disease.
- Persistent hyperuricaemia
    - after fluid therapy +
    - Normal:
        - Haematocrit, Total Protein and BUN
    - confirms a diagnosis of renal disease.

Phosphorus

Hyperphosphataemia is the hallmark in renal secondary hyperparathyroidism (RSHP), a consequence of chronic renal disease[3]. Renal failure and the resulting decreased filtration rates leads to phosphorus retention and hyperphosphataemia[3]. This can be associated with soft tissue calcification, renal osteodystrophy and hypocalcaemia[3]. A Ca:P ratio of < 1 is also a reliable diagnostic feature and in chronic renal disease is often the first biochemical indicator of renal disease[4].

Patient 1: Bob: an inland bearded dragon, *Pogona vitticeps*

- Wt: 290g
- Age:3 years old

History:

- Not eating and weight loss.
- Husbandry: Vivarium, heat mat, hot rock., has a UV light but not changed recently
- Diet: Crickets, endive

Clinical Examination: Exaggerated movements, hypermetria, female

Differential Diagnosis: Inanition, MBDs (renal, nutritional)

Diagnostic Plan: Collect blood for a Biochemistry Panel

Laboratory Tests: **In-House Lab - Abaxis**

Parameter	**Result**	**Normal**	**Comment**
PCV	42 %	17-28%	
Ca		2.2-6.8 mmol/L 1.99-4.99 mmol/l	
P		1.2-3.2 mmol/L	
Ca:P ratio	***0.67***	***0.9-3.8, < 1***	
AST	149 U/L	< 250 U/L	
Bile Acids	<35 umol/L	< 35	
CK	987 U/L	59-7000 U/L	
Uric Acid	***153 mmol/L***	***95-678 mmol/L***	
Glucose	19.4 mmol/L	7.72-16.2 mmol/L	
Total Protein	88 g/L	46-100 g/L	
Albumen	35 g/L		
Globulin	53 g/L		
Potassium	2.4 mmol/L	1-6.5 mmol/L	
Sodium	> 180 mmol/L		

Diagnosis: Renal disease - Metabolic Bone Disease
(renal secondary hyperparathyroidism)

Treatment Plan:

- Fluid therapy and assisted alimentation.
  - "reptile fluids" consisting of one part Hartmann's and two parts 0.45% sodium chloride and 2.5% glucose.
  - Hills a/d – maintain PBT and good hydration
- Palpate the abdomen regularly to guard against impaction from overenthusiastic alimentation.
- Calcium gluconate and calcium lactobionate PO
  - Calcium Sandoz®, Novartis - 10 mg per kg body weight bid.
- It is important to begin calcium therapy as early as possible, particularly in lizards showing weakness, muscle fasciculation or fitting.

Medications:

- Calcitonin??
  - only use when reptile is normocalcaemic
  - no more than two doses a week because →very low calcium → back to square one with a twitchy dragon.

- Ipakitine
  - phosphate binder,
  - dose = 1ml/500g body wt of solution (1g diluted in 9ml of water) bid PO.
  - Contents:
    - Lactose
    - $CaCO_3$
    - Dietary fibre
    - Hydrolysed soy protein.

Phosphate binders

- common adjunct to chronic renal disease in mammals are being used increasingly in reptiles.
- Hypocalcaemic animals
    - parathyroid hormone released
    - increases renal tubular resorption of calcium
    - at the same time increases phosphate excretion in the urine.
- Ipakitine will aid this process.

Result:

- Bob picked up.
- After five days in hospital he was discharged and sent home on a/d and Ipakitine BID.

Reproductive Problems

Possible diagnostic steps:

- FBC and Biochemistry Panel
- Radiography
- Ultrasonography
- Endoscopy

Haematology: if inflammation present will see pronounced heterophilia and azurophilia[4].

Azurophils

- Unique to Iguanas and some snakes and function similar to Monocyte
- Usually 0-10% but can be up to 20% in pythons and Iguanas

- Cytoplasm contains
    - numerous, fine, dustlike, eosinophilic granules.
    - overall red-purple colour
- Azurophilia
    - Granulomas (parasitic or bacteria)
    - Severe bacterial or viral infections
    - Allergenic challenge
    - Necrosis

Boa Constrictor with Inclusion Body Disease (Fudge, 2000)

- 6 year-old, Female Necropsy positive for IBD

	Presentation	Normal
WBC (mm3)	16,000	4,000-10,000
Heterophils %	25	20-50
Lymphocytes %	49	10-60
Monocytes %	22	0-3
Basophils	0	0-20
Comments	Toxic heterophils	Normal leukocyte morphology

Biochemistry:

- Tissue necrosis: increased LDH (non-specific) [4].
- Active egg formation elevated Calcium, cholesterol and triglycerides (physiological) [4].

Patient 2 Renal disease and preovulatory follicular stasis in a veiled chameleon, *Chamaeleo calyptorarus*

- **Sophia:** Veiled chameleon *Chamaeleo calyptorarus*
- Age: 2 years
- Wt: 60g

History: Not eating and listless

Clinical Examination: Muscle wastage, bloated body. Not bright or responsive, gravid.

Diagnostic Plan: Bloods to assess renal metabolism.

DDx: Renal disease, POFS (preovulatory follicular stasis)

Laboratory Tests: **In-House Lab - Abaxis**

Parameter	**Result**	**Normal**	**Comment**
Calcium	2.58 mmol/L	2.2-6.8 mmol/L 1.99-4.99 mmol/L	
Phosphorus	2.98 mmol/L	1.2-3.2 mmol/L	
Ca:P ratio	***0.86***	< 1	
AST	748 U/L	< 250 U/L	
Uric Acid	***613 umol/L***	< 400	
Total Protein	80 g/L	46-100 g/L	
Potassium	7.2 mmol/L	1-6.5 mmol/L	

Diagnosis : Renal disease and still suspected POFS

Rx:

- Fluid therapy ICoCa gluconate 100mg/ml, 0.07 mls IM.
- Ipakitine (1g in 9mls water) dose 0.1 ml PO bid.
- Hills a/d 0.3 mls PO.
- Heat & Humidity

Result: Died 24 hrs after admission.

Necropsy:

- Emaciated.
- Retained follicles, impaction of lower bowel, fatty liver, pale kidneys.

Diagnosis:

- Renal disease,
- POFS
- secondary bowel impaction
    - dehydration and reduced metabolic rate

Case3: *Chelodina expansa*, carapace deficit and dystocia - The squashed turtle

- Turtles are presented to veterinary clinics in various states of shell trauma.
- It is important to identify the extent of trauma to underlying soft tissue.
- Fractures of the bridge have a poor prognosis
    - often damage to the underlying viscera.
    - Male turtles may be presented throughout the year

Female Turtles

- Females are usually more likely to wander when seeking nesting sites in late spring and early summer.
- Veterinarians should become skilled in gender determination and radiograph all injured females.
- Injured egg bearing turtles may require induction of egg-laying.
- Treatment
    - Oxytocin (10-20 U/kg SC or intracoelomically [ICo])
    - Turtles usually lay eggs 30-60 minutes post injection.
        - If do not lay eggs – need Surgery
    - Warm water soaks.

Shell Fractures

- Repaired using a variety of techniques, including wiring and ultraviolet light cured dental composite.
- Often injured turtles need to be “overwintered” so wildlife carers must be well-versed in the specific nursing and husbandry needs of rehabilitating turtles.
    - A combination of “dry docking”, partial or total immersion may be required, depending upon the site of the injury.
    - Freshwater turtles will only eat in water, so methods must be devised to accommodate this habit and still keep wounds dry and clean.

Case 4: How to repair a fractured mandible in a Blue-tongue Lizard (Tiliqua scincoides)

Hints for repair of a fractured mandible in a blue tongue

This will be a pictorial presentation demonstrating the application of Fixomull® Strips over a standard office issue paper clip. This is then covered with Vetbond®. The combination of these products becomes firm when dried.

The aim is to demonstrate that simple solutions may be applied using products already present in most companion animal practices.

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NOTES:

Chapter 13

Small Mammal Case Reports

Dr Michael Cannon

Case 1. “Toast” the Much-Loved Rat

History

- UEP Yahoo site posting
- I have a rat with a large 3-4cm diameter abdominal mass, possibly a kidney as I can only see one on xray.
- desexed male
- still eating well
- aged 2years and 3months.
- Urinating and defaecating is normal
- he's waddling a bit due to the size of the mass.
- Organs are mainly displaced anteriorly.

Response

- Sure it's intra-abdominal? (Thinking of mammary tumours)
- Is he an entire male? (Prostate?)
  - He is desexed

Advice: Consider a FNA

Differential Diagnosis

- Fat
- Organomegaly
  - Tumour
    - Spontaneous Nephroblastoma
    - Spontaneous Eosinophilic Granulated Round Cell Tumors
  - Infection
- Ascites
- Aneurysm (Aorta)
- Cestode Cysts
  - *Taenia serialis* ,
  - *Taenia taeniaeformis*-induced Metastatic Hepatic Sarcoma

Aid to Diagnosis

- Ultrasound examination
- Fine Needle Aspirate
- CT Scan or MRI
- Exploratory Laparotomy

Case 2. "Doodles" the Lop-eared Rabbit

History

- Doodles weight = 2.2kg
- 9 yr age,
- Rescue animal with lameness and swelling around R hock.
- Acute onset 2 months ago.

Treatment

- Initial
    - Meloxicam PO and TMS 30mg/kg bid + Metronidazole 30mg/kg bid for 21 days
- No Rx for 3-4 weeks, then went to another vet
    - Enrofloxacin for 2 weeks and improved so were ceased.
    - Relapse 2 weeks ago and has been on Enrofloxacin (30mg/kg for 1 week).

Examination

- 10/10 lame RH
- swollen hock medial and lateral
- crepitus when manipulate hock
- multiple pustules visible under skin
- animal is thin & has reduced appetite
- passing reddish urine
    - normal in rabbits that are stressed - porphyrins

GA and exam

- compartmentalised multiple abscesses
- Collect blood for CBC
- Radiographs taken
- Swab of pus for C&S
    - aerobic and anaerobic (very important)
    - Usually these are Pasteurella multocida – but can be Staph aureus
        - Differentiate with a Gram Stain
            - Pasteurella = G –ve, Staph = G+ve).
- Cytology = pus is cellular, lots PMN and bacteria
- Pasteurella has haematogenous spread
    - can lodge anywhere and should be regarded as a systemic problem.

Anaesthesia

- Mask induction with Isoflurane
- Had an arrythmia on induction
    - Is this a problem?
        - Is probably normal
        - Stressed rabbits release catecholamines
    - Cardiac rhythm became normal when GA stabilised.

Anaesthesia

- Rabbits are sensitive to hypoxaemia
    - if not breathing need to intubate.
- When masking down
    - anticipate that rabbit may lunge forward into the mask, rather than try to back out
    - can be explosive
    - best protection is to be prepared.

Radiographs

- an enlarged heart and dorsal deviation trachea
- changes to hock
    - greater than would expect with the time frame given, so may have lodged in articular tissue (haematogenous spread)
- lots of ingesta in stomach and caecum
    - so is eating well
- Normal amount gas in SI loops

Other Considerations

- Strongly advise to check if has been spayed
    - many rabbits have uterine problems when >4-5 yrs.
- Rabbit hock
    - a common place for infections because is weight bearing and develop pressure sores
    - Check for obesity - diet and exercise levels
    - Provide soft substrate
        - Solid floor with straw, newspaper, towels etc.

Prevention

- Good exercise levels
    - Minimum 4 hours daily, free roaming.
- Avoid stress
    - Excessive Foot thumping leads to trauma
- Hygiene
    - clean enclosure daily
- Aged rabbits
    - Check for spondylosis causes hunched posture and change in pressure on feet

Clipping Fur

- beware clipping these
- the fur is protective from trauma
- Use topical treatment
    - lanoline based human creams
    - Silvazine
    - or treat as a bedsore – Duoderm
    - Many will tolerate bandages

Always Check their Teeth

Case 3. Alice" the Guinea Pig

History

- 2 yrs age
- Female
- Obese, 1.56kg
- Mass in Left Axilla
- Chronic Bilateral Eye discharge
    - Eyes had been treated with Tetracycline ointment but no improvement

Examination

- Bilateral ocular discharge
    - Both eyes fluorescein negative
- Cherry eye like mass in lower R conjunctival sac.
- Both conjunctivae reactive and swollen but worse on RHS.
- T=38.1C.
- Abdomen palpation = fluid and gas and fat but no masses detected
- Need GA with Isoflurane
    - Full Physical Examination
    - Radiographs
    - Blood for CBC and Biochem
        - collect from Vena Cava, same as Ferret.
    - Swab from each eye for C&S,

Anaesthesia

- Same as rabbits
- Hold in towel and mask down
- Then transfer to nose mask only
- Maintain Isoflurane at 5%.
- Under GA - increased respiratory sounds from upper airway mucous, settled on recovery

Endoscopy

- Mouth and Pharynx = AOK
  - Teeth more pointed than in rabbits
  - Always need check that lower teeth do not have lingual points that entrap tongue.

Initial Treatment

- Bacitracin/Neomycin/Polymixin ointment
- Await C&S results
- Check diet
  - All GP need Vitamin C supplement even if on good diet
  - Crush human tablet and give in water
  - Only lasts 6 hours as oxidised very quickly. Similar problem with loss in most foods.
  - Give 25mg/day at least. Some need 50-75mg/day.
  - Examine costo-chondral junction of ribs for signs Vit C deficiency. See lysis and swelling.

Culture & Sensitivity

- Left Eye
  - Staph aureus and Klebsiella
- Right Eye
  - Pseudomonas aeruginosa and Staph aureus
- For both growth = ++
- These are primary pathogens.
  - Pseudomonas normally need to use Aminoglycosides, some are resistant to Gentamicin and need to use Tobramycin (much more expensive).

Other Considerations

- Obesity
    - can lead to ballooned abdomen, Fatty Liver?
- Abdominal swelling
    - May be cystic ovaries
    - GP prone when aged
    - She has vaginal discharge and swollen vulva
        - may be normal cycling
        - but may exacerbate the cystic ovaries.

NOTES: